*Elizabeth City State University*

# Nurturing ECSU Research Talent (NERT & AASERT)

# 1997-98 Annual Report


## Funding Information

N00014-94-1-1089
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# N.E.R.T.

## Nurturing ECSU Research Talent
## Elizabeth City State University

This program, entitled "Nurturing ECSU Research Talent" focuses on undergraduate education and undergraduate research experiences. Nurturing these young researchers is a primary concern. Highest priority is given to providing them with the guidance and skills to insure their entrance and success in graduate school. Further, each student learns the fundamentals of scientific research, in a team setting, under the guidance of a faculty mentor. Program activities are as follows:

1. Student development activities

    a) Recruitment of high ability minority students;
    b) Providing a precollege/summer experience for recruited students;
    c) Providing research experiences;
    d) Providing a mentor, graduate school counseling and GRE preparation;
    e) Providing financial support for students in the form of research scholarships;
    f) Providing funds for student travel.

2. Infrastructure activities

    a) Enhancement of current computer graphics and operating systems courses;
    b) Development of a new course in computer visualization;
    c) Establishing a visiting lecture series in computer science;
    d) Providing UNIX network management support;
    e) Acquisition of computer equipment appropriate to support of research training.

# 1997-98 Undergraduate Research Teams

| Team Name | Mentors | Team Members (26) |
|---|---|---|
| Fractals/Chaos | Dr. D. Sengupta | Corey Ellis, Sr/Math<br>Tammara Ward, Sr/Math<br>Ayonda Moore, Jr/Math |
| JAVA | Dr. K Kulkarnie | Angela Mizelle Fr/CS<br>Lakisha Mundon, Jr/Math<br>Sheri Joyner, So/CS<br>Micheal Boisson, Fr/CS<br>Joseph Gale, Fr/CS |
| ATM Networks | Dr. L. Hayden<br>Mr. D. Archer<br>Ms. S. Saunders | Curtis Felton, Sr/CS<br>Fred Sessoms, Sr/CS<br>Charles Gatling, Sr/CS<br>Melvin Anderson, Sr/CS<br>Jamaal Turner, Sr/In Tech<br>Laverne Williams, Sr/CS<br>Derrek Burrus, Jr/CS<br>Antonio Rook, Jr/CS<br>Courtney Fields, Jr/CS |
| Visualization | Dr. K. Edoh | Kuchumbi Hayden, Jr/CS<br>Alicia Jones So/CS |
| Physics | Dr. A. L. Choudhury | Santiel Creekmore, Jr/Phy<br>Katrina Godwin, So/CS<br>Arthur Fenner Sr/MAth |
| Multimedia | Dr. L. Hayden<br>Mrs. Amie Aydlett | Jonathan Williams, Fr/CS<br>Donald Charity So/Math<br>Je'aime Powell, Fr/CS |

ONR/NASA Summer 1998 Summer Placement/Internship Report

| name | class | summer placement/internship |
|---|---|---|
| Boisson, Michael | FR | Newport News Naval Shipyard |
| Gale, Michael | FR | ONR-AASERT Summer Research Program |
| Mizelle, Angela | FR | ONR-AASERT Summer Research Program |
| Powell, Je'aime | FR | ONR-AASERT Summer Research Program |
| Williams, Jonatha | FR | ONR-AASERT Summer Research Program |
| Charity, Donald | SO | ONR- Naval Research Lab |
| Godwin, Katrina | SO | NASA-Kennedy Space Craft Center |
| Jones, Alicia | SO | ONR- Naval Research Lab (Ronald McNair) |
| Joyner, Sheri | SO | ORISE Dept. of Energy (Ronald McNair) |
| Burrus, Derrek | JR | U S Coast Guard |
| Creekmore, Santie | JR | NSU-Institute in Materials Science(Ronald McNair) |
| Fields, Courtney | JR | Department of Energy |
| Hayden, Kuchumbi | JR | Ronald McNair Research Program |
| Moore, Ayonda | JR | Virginia Tech Summer Program(Ronald McNair) |
| Mundon, Lakisha | JR | Ronald McNair Research Program |
| Rook, Antonio | JR | University of Alabama Summer Research |
| Anderson, Melvin | SR | NC A&T Grad School +MSU High Performance Computing |
| Ellis, Corey | SR | IBM and New Mexico State University Fellowship |
| Felton, Curtis | SR | NC A&T Grad School + FermiLab |
| Fenner, Arthur | SR | Dept. of Energy |
| Gatling, Charles | SR | NC A&T Grad School +MSU High Performance Computing |
| Sessoms, Fred | SR | IBM |
| Turner, Jamaal | SR | Dept. of Transportation |
| Ward, Tammara | SR | IBM |
| Williams, Laverne | SR | FermiLab + Michigan State Univ. GEM Fellowship |

# 1997-98 Enrollment and GPA Report

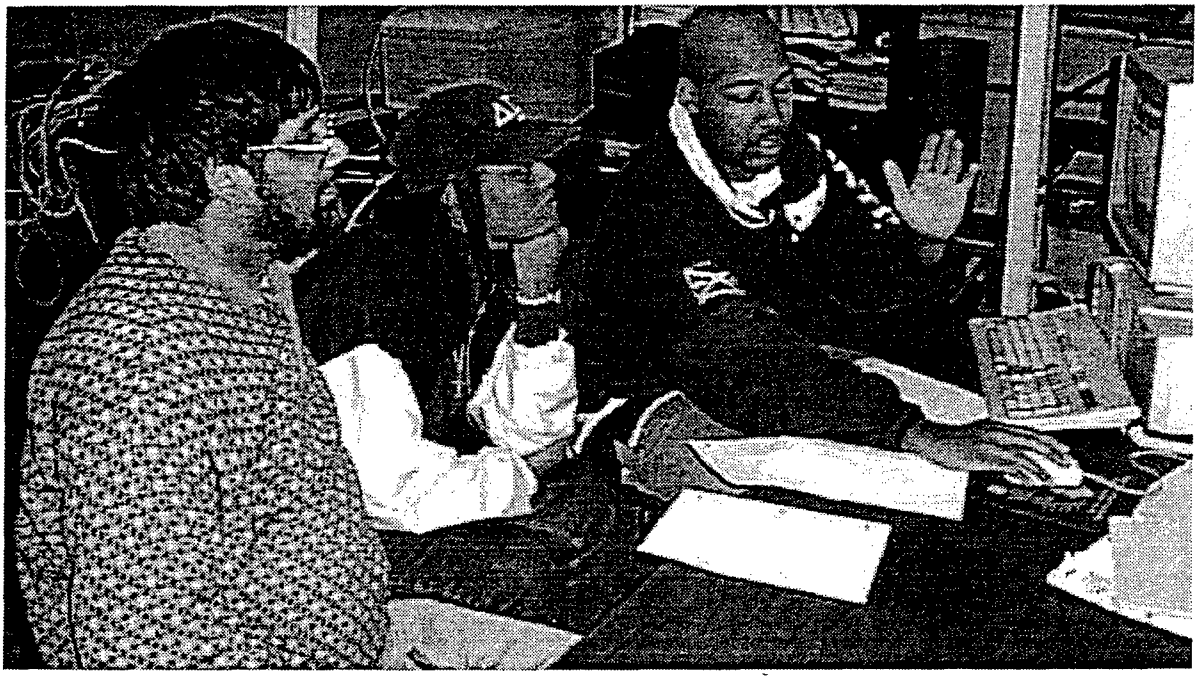
| Major Discipline | Total Enrollment | | | | ONR Enrollment | | | | Total Graduated | Total Prof. School | ONR Prof. School |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | FR | SO | JR | SR | FR | SO | JR | SR | | | |
| Engineering | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| Biology | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| Chemistry | 3 | 3 | 6 | 4 | 0 | 0 | 0 | 0 | 4 | 2 | 0 |
| Computer Science | 63 | 30 | 39 | 29 | 5 | 2 | 3 | 5 | 29 | 4 | 4 |
| Mathematics | 5 | 7 | 10 | 15 | 0 | 1 | 2 | 3 | 14 | 0 | 0 |
| Physics | 1 | 1 | 1 | 3 | 0 | 0 | 1 | 0 | 1 | 0 | 0 |
| Totals | 72 | 41 | 56 | 51 | 5 | 3 | 6 | 8 | 48 | 6 | 4 |

| Class Year | Mean GPA for all Students | Mean GPA for ONR Students |
|---|---|---|
| Freshman | 2.147 | 3.047 |
| Sophmore | 1.953 | 3.736 |
| Junior | 3.056 | 3.204 |
| Senior | 3.183 | 3.408 |

# Graduate Success Program Results

| Name | University | Degree Sought/Earned |
|---|---|---|
| Jovita Harrell | Hampton | Masters Computer Science |
| Renee Basnight | Hampton | Masters Computer Science |
| Chonda Gayle | Hampton | Masters Computer Science |
| Eva Dail Koltuniak | Hampton | Masters Computer Science |
| Tim McCray | Hampton | Masters Computer Science |
| Sharon Saunders | Hampton | Masters Computer Science |
| Michelle Brown-Emmanual | Hampton | Masters Computer Science |
| Karen Felton | Duke | Masters Chemistry |
| Stephanie Vaughan | Hampton | Masters Computer Science |
| Cathy Thomas | Ohio State | Masters Computer Science |
| Felicia Bowser | North Carolina State | Masters Computer Science |
| Clarence Jones | Hampton | Masters Physics |
| Michael Fields | Hampton | Masters Physics |
| Bonnie Gardner | Maryland | Masters Computer Science |
| Stacia McFadden | Michigan State | Masters Computer Science |
| Cultilda Monk | Fayetteville | Math Education |
| Kim Gordon | Virginia State | Masters Mathematics |
| Darnley Archer | Old Dominion | Masters Computer Science |
| Brian Jordan | Hampton | Masters Mathematics |
| Belinda Banks | Norfolk State | Masters Communications |
| Abdula Fofana | Howard | Masters Computer Science |
| Charles Gatling | North Carolina A&T | Masters Computer Science |
| Melvin Anderson | North Carolina A&T | Masters Computer Science |
| Curtis Felton | North Carolina A&T | Masters Computer Science |
| Laverne Williams | Michigan State | Masters Computer Science |
| Teresa Bright | Ohio State | Masters Computer Science |

# Fractals / Chaos
# &
# Dynamical Systems



*Team Mentor: Dr. D. Sengupta*

*Team Members: Ayonda Moore*
*Corey Ellis*
*Tammara Ward (not shown)*

# Appendix B

# Mathematica Program

## B.1 Harmonic Oscillator Program

This program was designed to graphically show the Harmonic Oscillator Model (Homogeneous).

```
Clear[a,b,c,t]

a = 1;
b = -5;
c = 6;

If[b^2-4 a c == 0,
r = -b/(2 a);
x1[t_] := Exp[r t];
x2[t_] := t Exp[r t];
,
If[b^2-4 a c ¡ 0,
w = Sqrt[4 a c -b^2]/(2 a);
r = -b/(2 a);
x1[t_] := Exp[r t]Cos[w t];
x2[t_] := Exp[r t]Sin[w t];
,
r1 =(-b + Sqrt[b^2-4 a c)/(2 a);
r2 =(-b - Sqrt[b^2-4 a c)/(2 a);
t = 0;
m = {{x1[t],x2[t]},{y1[t],y2[t]}};
TableForm[m];
xi = 0.0;
yi = 1.0;
Coefs = LinearSolve[m, {xi,yi}];
k1 = Coefs[[1]]
k2 = Coefs[[2]]
Clear[t]
x[t];
Plot[x[t],{t,0,3}]
ParametricPlot[x[t],y[t],{t,0,10}]
```



# Bibliography


[1] Boyce W. and DiPrima R., *Elementary Differential Equations and Boundary Value Problems.* 4th edition. John-Wiley & Sons, 1986.

[2] Devaney R., Blanchard and Hall., *Dynamical Systems approach in Differential Equations.* Addison-Wesley, 1997.

[3] Hubbard J. and West B., *MacMath: A Dynamical Systems Software Package for the Macintosh.* Springer-Verlag, New York, 1991.

[4] Stroyan K.D., *Calculus using Mathematica* (Academic Press, New York, 1993)

## Abstract

In this Project we will begin the systemic study of "differential equation". This study will not be a study of an equation and tricks to 'solve' it, but rather of the dynamic 'movement' produced by the differential equation.

A differential equation describes 'how things change', and if we know where we start, we should be able to predict where we go and how fast. The 'systems' we will study here are families of initial value problems (I.V.P.) given by a differential equation and a starting position.

One good analogy for a mathematical dynamical system is the 'flow' on the surface of a smoothly moving river. The differential equations corresponds to the velocity vector at each point on the surface, while the collection of paths of all the water particles constitute the solution flow. In this project we will study numerical, graphical and symbolic description of mathematical flows determined by a differential equation and its initial conditions. This will shed new light by analyzing them geometrically. Geometry is a powerful qualitative tool to answer the 'where we go' questions. Numerics and symbolics answer quantatively 'how fast questions'.

In this project we will explicitly analyze and solve several models which leads to linear and nonlinear differential equations using Mathematica. We will mainly concentrate on the following issues:

1. What are the assumptions that go into describing change mathematically
2. What dynamic movement does the change law produce?


"A dynamical system is a mathematical way of describing a system that changes [3, pg 1]." In the previous research the approach one used to analyze the dynamical systems was iteration. Now the approach one will be focusing attention on will be differential equations.

### Differential Equations vs. Iteration

Both differential equations and iteration are commonly used to model real life phenomenon i.e., population; and either approach might be applied to the same situation [3, pg 4]. One might think that iteration would be the easier approach to use, particularly since the calculus of the derivatives is avoided. Conceptually this is a correct assumption, but iteration methods do not always predict the motions (orbits) correctly [3, pg 4]. Therefore, another approach must be used for analysis on certain dynamical systems.

### Differential Equations

Differential equations has long been a field in which a mathematician could spend a lifetime. The best understood differential equations are, as one might expect, linear differential equations. Nonlinear equations are far more of a challenge because of the lack of knowledge one has about them.

When solving differential equations analytical, numerical, and graphical techniques can be used. Most of these differential equations in general do not lend themselves to special analytical methods [3, pg 5]. When modeling real-life situations using differential equations, analytical methods for finding solutions is not a recommended approach. The reason is an overall understanding of the model can not be obtained usually with analytical methods. An approach that gives a overall solution to the system is the qualitative (graphical) approach.

Differential equations can now be visualized using computer graphics, but they must be in one of three forms, one-dimensional, two-dimensional, or three-dimensional. The example that was analyzed was a two-dimensional linear dynamical system.

## Qualitative Technique: Slope Fields

Whenever possible, it is useful to have a visual representation for a mathematical problem. This is especially true for differential equations. Slope fields is a method developed for visualizing graphically the graphs of the solutions to differential equations [3, pg 34]:

$$\frac{dy}{dt} = f(t, y)$$

"If the function $y(t)$ is a solution of the equation $\frac{dy}{dt} = f(t, y)$, and if its graph passes through the point $(t_1, y_1)$ where $y_1 = y(t_1)$, then the differential equation says that the derivative $\frac{dy}{dt}$ at $t = t_1$ is given by the value $f(t_1, y_1)$ [3, pg 34]." In other words the slope of the tangent line to the graph $y(t)$ at any point $(t_1, y_1)$ is the number $f(t, y)$

The example shown below is the slope field of $\frac{dy}{dt} = -2ty^2$. To calculate this one chooses two coordinates, in this case the coordinates are (t,y). Given values of $t$ and $y$ one finds the value of the slope at that particular point. So for $(1, 1)$ the slope, $\frac{dy}{dt}$ would be $-2$. (See Figure 0.1)

### Example of Slope Field

### Harmonic Oscillator

The goal is to establish a working mathematical model using differential equations that describes the motion of an object of mass ,$m$, suspended on an spring with spring constant ,$s$, and moving in a fluid that produces a restoring friction force proportional to speed, $-c\frac{dx}{dt}$.

Using Newton's law ($F = mA$) the model becomes

$$m\frac{d^2x}{dt^2} = -c\frac{dx}{dt} - sx$$

where $x$ is the displacement of the spring and $t$ is time [4, pg 447].

### Derivation of the Model



-Graphics-

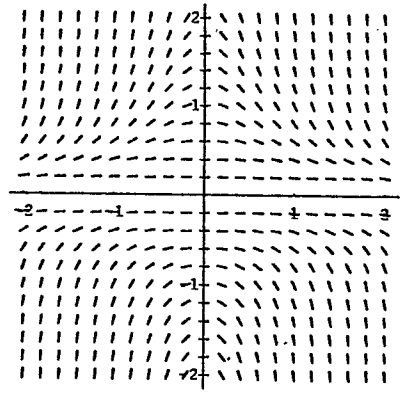



Figure 0.1: Slope Field of $\frac{dy}{dt} = -2ty^2$

Newton's law ($F = mA$) states that the total applied force equals the mass times acceleration that the force produces. Using this equation one obtains mass ,$m$, and acceleration which is the second derivative.

$$m\frac{d^2x}{dt^2} = F$$

Now to derive the force one needs to visualize all the forces acting. There are two forces acting that one is going to assume. They are the Shock Absorber Force and the Spring Force. Other forces can be added to the model, but the model tends to become more difficult. The spring force can be represented as ,$-sx$. When one strecthes a string of length ,$x$, the restoring force acting on the displacement is negative. Likewise when the spring is compressed, this suggest that the displacement ($x < 0$) is negative. Therefore the restoring force becomes positive.

The force of the shock absorber can be represented as, $-c\frac{dx}{dt}$. This force is also negative for the same reason concerning displacement. The researcher is using a derivative here because velocity as to be measured.

One may think of this equation ($m\frac{d^2x}{dt^2} = -c\frac{dx}{dt} - sx$) as a model of a car when it goes over a bump. The constants $m$,$c$, and $s$ are describing the design of the car for small periods of time. When the shock absorber wears out, $c$ becomes smaller. When the car rides over a bump very fast, and the car has a good shock; then one expects the car to reach equilibrium at a reasonable amount of time. This differential equation will model all of these scenarios for the performance of a vehicle's shock absorber.

### Analyzing the Model

Phase Variable Trick:

The researcher first wants to analyze this model as a two-dimensional system by introducing a "phase variable", $\frac{dx}{dt} = y$.

Essentially the model,

$$(m\frac{d^2x}{dt^2} = -c\frac{dx}{dt} - sx)$$

can be rewrote as

$$m\frac{dy}{dt} = m\frac{d^2x}{dt^2} = -c\frac{dx}{dt} - sx = -cy - sx$$

because

$$\frac{dy}{dt} = \frac{d}{dt}(\frac{dx}{dt}) = \frac{d^2x}{dt^2}$$

If one combines these two equations one creates a system of first order equations,

$$\frac{dx}{dt} = y \qquad \frac{dy}{dt} = \frac{-s}{m}x - \frac{c}{m}y$$

Linear Classification

This linear system is a variant of

$$\begin{aligned} \frac{dx}{dt} &= a_1x + a_2y \\ \frac{dy}{dt} &= b_1x + b_2y \end{aligned}$$



where

$$a_1 = 0 \qquad a_2 = 1$$

$$b_1 = \frac{-s}{m} \qquad b_2 = \frac{-c}{m}$$

This can be shown in matrix form:

$$\begin{bmatrix} \dot{x} \\ \dot{y} \end{bmatrix} = \begin{bmatrix} a & b \\ c & d \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix}$$

or,

$$\dot{x} = Ax$$

$$\dot{x} = ax + by \tag{0.1}$$

$$\ddot{x} = a\,\dot{x} + b\,\dot{y} \tag{0.2}$$

$$\ddot{x} = a\,\dot{x} + b(cx + dy) \tag{0.3}$$

$$\ddot{x} = a\,\dot{x} + bcx + bdy \tag{0.4}$$

$$d\,\dot{x} = adx + bdy \tag{0.5}$$

By subtracting equations 6.4 and 6.5 one gets,

$$\ddot{x} - d\,\dot{x} = a\,\dot{x} + (bc - ad)x$$

$$\ddot{x} - (a + d)\,\dot{x} + (ad - bc)x = 0$$

One can say that $(a+d)$ is the *tra* of the matrix A and $(ad-bc)$ is the *det* of the matrix A.

Therefore the characteristic equation is

$$\lambda^2 - tra\,\lambda + det\,A = 0 \tag{0.6}$$

and

$$\lambda = \frac{tra \pm \sqrt{(tra)^2 - 4\,det\,A}}{2}$$

The discriminant is equal to $(tra)^2 - 4\ det\ A$.

The characteristic equation obtained using linear differential equations is the same characteristic equation obtained from

$$det \begin{bmatrix} a-\lambda & b \\ c & d-\lambda \end{bmatrix} = 0$$

$$(a-\lambda)(d-\lambda) - bc = 0 \tag{0.7}$$

$$ad - a\lambda - d\lambda + \lambda^2 = 0 \tag{0.8}$$

$$\lambda^2 - \lambda(a+d) + ad - bc = 0 \tag{0.9}$$

As one can see equations 6.6 and 6.9 are essentially the same equation. This shows the direct relation between linear systems of differential equations and linear algebra methods.

The equilibrium point of this shock absorber model is at the origin (0,0). This is obvious because the force of the shock is either going to stop (attract) or it will continue infinitely (repell). When modeling the shock absorber one knows that the force could never repell from the fixed point because this implies that the car would never stop bouncing after it hits a bump, but to gain a theoretical picture of the model and complete understanding this unrealistic behavior must be shown. Complete understanding of this system will lead to the basic idea "nonlinear phenomena locally look linear [4, pg 441]."

Symbolic Exponential Analysis:

This method of analysis suggest one assumes the solution to the model is exponential. Let's first consider the second-order differential equation which is exactly like the harmonic oscillator model with different variables.

$$a\frac{d^2x}{dt^2} + b\frac{dx}{dt} + cx = 0$$



Now assume the solution is of exponential form $x(t) = e^{rt}$.

$$\begin{aligned} x &= e^{rt} & cx &= ce^t \\ \frac{dx}{dt} &= re^{rt} & b\frac{dx}{dt} &= bre^{rt} \\ \frac{d^2x}{dt^2} &= r^2e^{rt} & a\frac{d^2x}{dt^2} &= ar^2e^{rt} \end{aligned}$$

Therefore,

$$a\frac{d^2x}{dt^2} + b\frac{dx}{dt} + cx = (ar^2 + br + c)e^{rt}$$

There is no time when $e^{rt} = 0$, so one must set $(ar^2 + br + c) = 0$ to satisfy the equation.

Now one has reduced the differential equation into a algebra problem. This algebraic equation $(ar^2 + br + c) = 0$ is called the *characteristic equation* of the differential equation and the roots of the characteristic equation are called *characteristic roots* [4, pg 450].

Then one summarized the basic solutions of second order differential equations which models the shock absorber in the following theorem.

<u>Theorem</u>

The following procedure gives a pair of linear independent basic solutions to the differential equation

$$a\frac{d^2x}{dt^2} + b\frac{dx}{dt} + cx = 0$$

in the case when $a \neq 0$.

Find the solutions $r_1$ and $r_2$ of the characteristic equation $ar^2 + br + c = 0$

1. If the roots is repeated, $r_1 = r_2$, then $x_1(t) = e^{r_1 t}$ and $x_2(t) = te^{r_1 t}$
2. If the roots are real and distinct, then $x_1(t) = e^{r_1 t}$ and $x_2(t) = e^{r_2 t}$
3. If the roots are a complex conjugate pair $r_1 = \alpha + i\beta$ and $r_2 = \alpha - i\beta$, then $x_1(t) = e^{\alpha t}\cos(\beta t)$ and $x_2(t) = e^{\alpha t}\sin(\beta t)$

Every solution to this differential equation can be written as $x(t) = k_1x_1(t) + k_2x_2(t)$ for suitable choices of constants $k_1$ and $k_2$. The researcher wrote a Mathematica Program to understand the dynamics of the solution graphically for different initial conditions $x(0) = x_0$, $y(0) = \frac{dx}{dt}(0) = y_0$, and different values of a, b, c (appendix B).

To summarize the study of the dynamics of second order differential equations the following various possibilities can occur in the dynamics.

**Stability Analysis**

Now using this characteristic equation for different values of $a$,$b$,$c$ one can visualize what the model is doing. One wants to find out when the solution of the differential equation attracts or repells from the equilibrium point. The equilibrium points being the characteristic roots of the charcacteristic equation.

There are eight cases that can possibly occur and must be checked. The reference pictures for these eight cases can be seen in Appendix A.

Using Mathematica one is able to check each of these cases to determine whether the solution attracted or repelled (Table 0.1). Each particular case can be proven analytically also. Here are examples of two cases.

Example: Roots are distinct and negative

Assume the roots are $r_1 = -1$, $r_2 = -2$.

This suggest that the characteristic equation is

$$\begin{aligned}(r+1)(r+2) &= 0\\ r^2+3r+2 &= 0\ .\end{aligned}$$

Therefore if one takes the limit of $y = c_1e^{-t} + c_2e^{-2t}$ as $t$ approaches infinity one can see that the solution attracts to the equilibrium value.



Example: Roots are distinct and positive

Assume the roots are $r_1 = 1$, $r_2 = 2$.

This suggest that the characteristic equation is

$$\begin{aligned}(r-1)^2 &= 0\\ r^2-2r+1 &= 0\end{aligned}$$

Therefore if one takes the limit of $y = c_1e^t + c_2e^{2t}$ as $t$ approaches infinity one can see that the solution repells to the equilibrium value.

All of these cases can be shown graphically. Figure 0.2 shows the region where each case is stable. Hence one has predicted the long term behavior of the harmonic oscillator (homogeneous case) [1, pg 470].

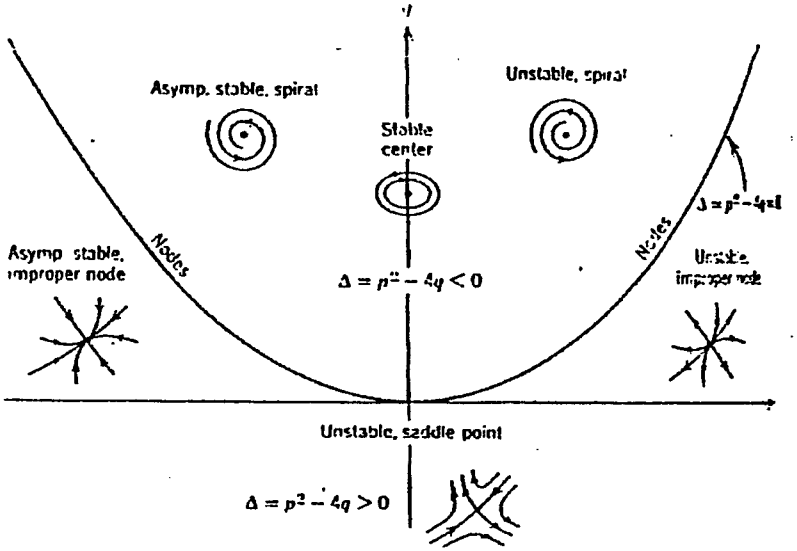



Figure 0.2: Stability Diagram

| Possible Cases | Phase Portrait | App. C |
|---|---|---|
| Roots are distinct and negative | Attracting Proper Node | A.1 |
| Roots are repeated and negative | Attracting Improper Node | A.2 |
| Roots are complex but negative real part | Attracting Spiral | A.3 |
| Roots are complex but with zero real part | Stable Center | A.4 |
| Roots are distinct and positive | Repelling Proper Node | A.5 |
| Roots are repeated and positive | Repelling Degenerate Node | A.6 |
| Roots are complex but positive real part | Repelling Spiral | A.7 |
| Roots are real but opposite of signs | Saddle | A.8 |

Table 0.1: Shock Absorber's possible cases



# Appendix A

# Shock Absorber – Reference Pictures

## A.1 Reference Picture 1 — Shock Absorber

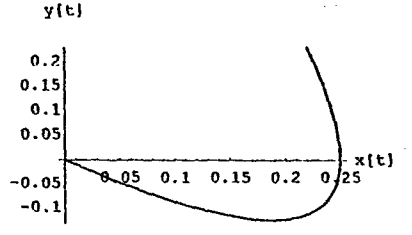



Figure A.1: Shock Absorber — roots are distinct and negative

## A.2 Reference Picture 2 — Shock Absorber

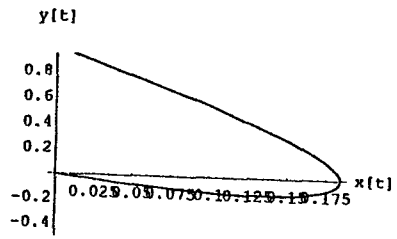



Figure A.2: Shock Absorber — roots are repeated and negative

## A.3 Reference Picture 3 — Shock Absorber

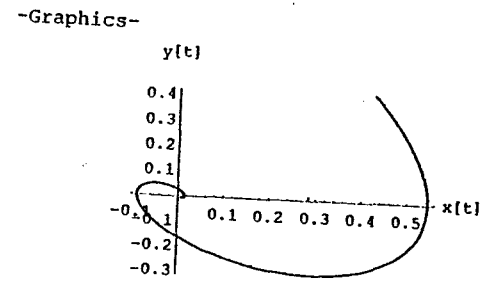



Figure A.3: Shock Absorber — roots are complex but negative real part

## A.4 Reference Picture 4 — Shock Absorber

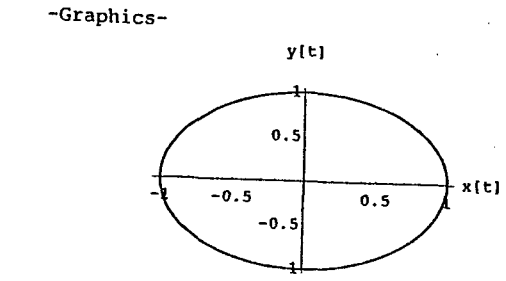



Figure A.4: Shock Absorber — roots are complex but zero real part

## A.7 Reference Picture 7 — Shock Absorber

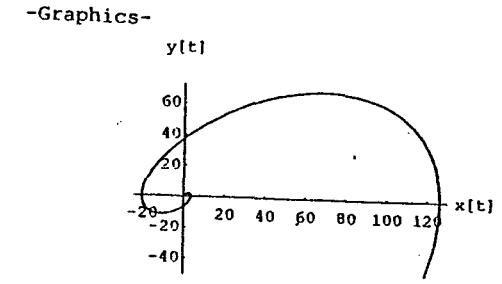
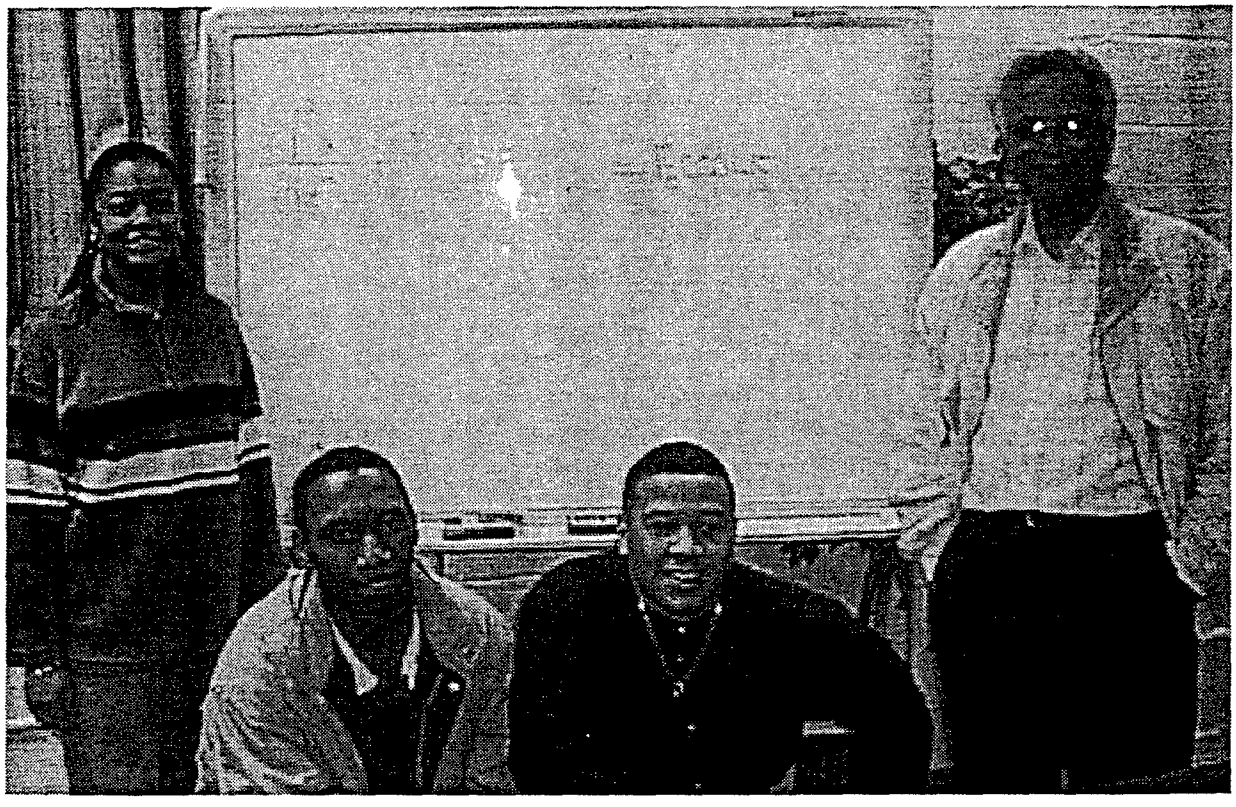



Figure A.7: Shock Absorber — roots are complex but positive real part

# Physics



*Team Mentor: Dr. L. Choudhury*

*Team Members: Santiel Creekmore*
*Katrina Godwin*
*Arthur Fenner*

# *Power Dissipation of a Damped Harmonic Oscillator Under the Influence of a Periodic Driving Force*


**PHYSICS TEAM:**
**SANTIEL J. CREEKMORE**
**ARTHUR FENNER**
**KATRINA Y. GODWIN**

**MENTOR:**
**Dr. A. L. Choudhury**
**Department of Physics**
**Elizabeth City State University**







Abstract:

In this work we carry out mathematical formulation of the average power dissipation of a damped harmonic oscillator under the influence of a periodic driving force. We set up the equation of motion of a mass *m*, according to the second law of Newton, tied to a spring moving under the simultaneous action of the air resistance and a periodic force. It leads to an inhomogeneous second order linear differential equation. We solve the equation rigorously. Regulating the parameters, we can make the homogeneous part of the solution dampen rapidly. We then calculate the average power of the system over the period of the driving force. We get:

$$P_{av} = \frac{F_0^2 4\gamma^2\omega^2}{4\gamma m\left[(\omega^2-\omega_0^2)^2 + 4\gamma^2\omega^2\right]}$$

Where wo is the intrinsic angular frequency of the spring, w is the angular frequency of the driving force, g is the dampening parameter, and FO is the magnitude of the driving force. We finally develop a Mathematical program to plot a three dimensional diagram of the average power depending on w and g. We explicitly demonstrate how the power increases as the driving frequency approaches the resonating frequency of the spring.


Introduction:

Harmonic oscillators play an important role in physical processes. In its simplest version, we create it by tying a mass to one end of a spring and keeping the other end fixed and letting it slide on a horizontal perfectly smooth plane as shown in Figure 1. We drag the mass *m:*

to a position xO and then let the mass go. The mass m then generates a simple harmonic motion. It moves back and forth about a fixed point. Under the restraining action of air resistance, it generates a damped motion.

In nature we encounter such a vibration very frequently. Every molecule of a crystal executes simple harmonic motion. When a wheel of a watch oscillates, it generally executes simple harmonic motion. Similar motion can also be found in a pendulum.

We can then subject that mass to a periodic force. The motion of mass under this periodic force is very interesting for engineers and physicists.

In this work we study rigorously the basic idea involving this motion. We set up the flindamental equation for the position of the mass, starting from Newton's second law of motion.

In section 2, we set up that equation and convert it into a second order differential equation of degree one. This equation turns out to be an inhomogeneous differential equation. We then solve this equation rigorously.

We use this solution to find the power of the system in section 3. Then we find the average power dissipation under the assumption that the system damps rapidly. In section 4, we first develop Mathematica program to graph the amplitude of the wave. We also write a program to generate a three dimensional graph of the average power as a function of two parameters. We demonstrate clearly the resonating shape of the average power. In section 5, we make some concluding remarks.

## 2. Equation of Motion for Harmonic Oscillator

If a mass attached to a spring is pulled to a length $x_0$ and then let go, the force it is subjected to is given by

$$(2.1) \quad F = F_s + F_r$$

where

$$(2.2) \quad Fs = -kx \quad \text{and} \quad Fr = bv_x$$

In Eq.(2.2) k is the spring constant, and in (2.3) b is the proportionality constant of the air-resistance. The equation of motion becomes

$$(2.3) \quad m\frac{d^2x}{dt^2} = F.$$

We can change the whole equation into the following form:

$$(2.4) \quad \frac{d^2x}{dt^2} + 2\gamma\frac{dx}{dt} + \omega_0{}^2x = 0$$

where we have set

$$(2.5) \quad \gamma = \frac{b}{2m} \quad \text{and} \quad \omega_0{}^2 = \frac{k}{m}.$$

If we set a test solution $x = e^{pt}$,the auxllary equation turns out to be

$$(2.6) \quad p^2 + 2\gamma p + \omega_0{}^2 = 0.$$

The solution of this quadratic equation becomes

$$(2.7) \quad p = -\gamma \pm i\omega_1$$

where

$$(2.8) \quad \omega_1{}^2 = \omega_0{}^2 - \gamma^2.$$

We want to generate a damped oscillatory motion, we choose

$$(2.9)\quad \omega_0^2 < \gamma^2.$$

The final solution turns out to be

$$(2.10)\quad x = Ae^{\gamma t}\cos(\omega_1 t + \theta)$$

where A and $\theta$ are two arbitrary constants.

The energy of the damped oscillator is given by

$$E = \frac{m\dot{x}^2}{2} + \frac{kx^2}{2}$$

$$= \frac{mA^2e^{-2\gamma t}}{2}[\gamma^2\cos^2(\omega_1 t + \theta) + \omega_1^2\sin^2(\omega_1 t + \theta) + 2\gamma\omega_1\cos^2(\omega_1 t + \theta)] + \frac{kA^2e^{-2\gamma t}}{2}[\cos^2(\omega_1 t + \theta)].$$

In the limit $\gamma$-->0, $\omega_0 >> \gamma$, we get

$$(2.12)\quad E = \frac{kA^2e^{-2\gamma t}}{2}.$$

In that limit the rate of change of ln E becomes:

$$(2.13)\quad \frac{1}{E}\frac{dE}{dt} = -2\gamma.$$

In addition if we now add a periodic force

$$(2.14)\quad F_p = F_0\cos\omega t$$

the equation of motion changes into the following form

$$(2.15)\quad \frac{d^2x}{dt^2} + 2\gamma\frac{dx}{dt} + \omega_0^2 x = F_0\cos\omega t.$$

To solve the equation, we introduce an extra equation

$$(2.16)\quad \frac{d^2y}{dt^2} + 2\gamma\frac{dy}{dt} + \omega_0^2 y = F_0\sin\omega t.$$

Introducing an amplitude z defined by the relation

$$(2.17)\quad z = x + iy$$

we can combine Eqs. (2.13) and (2.14) into the form

$$(2.18)\quad \frac{d^2z}{dt^2} + 2\gamma\frac{dz}{dt} + \omega_0^2 z = \frac{F_0e^{i\omega t}}{m}.$$

The solution of Eq(2.17) can be written as

$$(2.19)\quad z = z_H + z_P$$

where $z_H$ satisfies the equation

$$\frac{d^2 Z_H}{dt^2} + 2\gamma \frac{dZ_H}{dt} + \omega_0^2 Z_H = 0 \tag{2.20}$$

and $Z_p$, the particular solution, satisfies

$$\frac{d^2 Z_p}{dt^2} + 2\gamma \frac{dZ_p}{dt} + \omega_0^2 Z_p = \frac{F_0}{m} e^{i\omega t} \tag{2.21}$$

The solution of Eq.(2.20) has exactly the same form as of Eq(2.10), that is

$$Z_H = Ae^{-\gamma t} \cos(\omega_1 t + \theta) \tag{2.22}$$

To obtain the particular solution, we set the test form of $Z_p$ as

$$Z_p = Be^{i\omega t} \tag{2.23}$$

Substituting this form in Eq(2.21), we find

$$B = \frac{F_0/m}{\omega_0^2 - \omega^2 + i2\gamma\omega} \tag{2.24}$$

Rationalizing the denominator we find

$$Z_p = \frac{\frac{F_0}{m} e^{i\left[\omega t - \tan^{-1}\frac{2\gamma\omega}{\omega_0^2 - \omega^2}\right]}}{\sqrt{(\omega^2 - \omega_0^2)^2 + 4\gamma^2\omega^2}} \tag{2.25}$$

The $X_p$ comes out to be

$$X_p = R_e Z$$
$$= R_e Z_H + R_e Z_p$$

$$X_p = Ae^{-\gamma t} \cos(\omega_1 t + \theta) + \frac{F_0}{m} \frac{\cos\left(\omega t - \tan^{-1}\frac{2\gamma\omega}{\omega_0^2 - \omega^2}\right)}{\sqrt{\left(\omega^2 - \omega_0^2\right)^2 + 4\gamma^2\omega^2}} \tag{2.26}$$

where we have chosen A and theta to be real.

Introducing

$$\beta = \frac{\pi}{2} - \overline{\beta} \tag{2.27}$$

where

$$\overline{\beta} = \tan^{-1}\frac{2\gamma\omega}{\omega_0^2 - \omega^2} \tag{2.28}$$

We can write

$$X = Ae^{-\gamma t} \cos\left(\omega_1 t + \theta\right) + \frac{F_0}{m} \frac{\sin\left(\omega t + \beta\right)}{\sqrt{\left(\omega^2 - \omega_0^2\right)^2 + 4\gamma^2\omega^2}} \tag{2.29}$$

The first term, called the tarsient state disappears after a sufficiently long time. The second term is called the steady state.

3. Average Power

In a steady state, the power is given by the expression:

P = Driving Force * Speed
$= F_p * V_x$

$$P = D(\omega)\left[\left(\cos^2 \omega t\right)\cos\beta - \frac{1}{2}\sin 2\omega t\left(\sin\beta\right)\right] \tag{3.1}$$

where we have set

$$D(\omega) = \frac{F_0^2 \omega}{m\sqrt{\left(\omega^2 - \omega_0^2\right)^2 + 4\gamma^2\omega^2}} \tag{3.2}$$

We define the average power, $P_{av}$ as

$$P_{av} = \frac{1}{T}\int_0^T P\,dt \tag{3.3}$$

whose T = 2 Pi / w, which is the period of the driving force.

We get

$$P_{av} = \frac{\omega}{2\pi} D(\omega)\left[(\cos\beta) I_1 - \frac{1}{2}(\sin\beta) I_2\right] \tag{3.4}$$

whose

$$I_1 = \int_0^{\frac{2\pi}{\omega}} \cos^2 \omega t\, dt = \frac{\pi}{\omega}$$

$$I_2 = \int_0^{\frac{2\pi}{\omega}} \sin 2\omega t\, dt = 0 \tag{3.5, 3.6}$$

Then we get

$$P_{av} = \frac{F_0}{4\gamma m} \frac{4\gamma^2\omega^2}{\left(\omega_0^2 - \omega^2\right)^2 + 4\gamma^2\omega^2} \tag{3.7}$$

Finally we plot the average power $P_{av}$ from different perspective. The program runs as follows:

```
F[w_,g_] = A(g w^2)/((w^2-w_0^2)^2 + 4g^2w^2);
A=1; w_0 = 3;

Plot 3D->[F[w,g],{w,0,5},{g,.001,3}, Plot Range->{0,1}
ViewPoint -> {a,b,c}, Axes Label->{w,g,Pav}]
```

For ViewPoint-> default we get the outcome in Fig. 6.

For a=5,b=0,c=0, we get the sideview as shown in Fig7. Fig8. gives the backside view. We notice that the resonance is prominant at $w=w_0$.

5.Concluding Remarks

We have taken a simple vibrating systemand demonstated how to solve the problem using funmdamental methods of differential equation. The solution obtaned for has been plootted using Mathematica Program. We found out that the driving force dominates the power dissipation rapidly dempending an t;he value of the dampong factor gamma. It will be very interesting to study the effect on such resonance with a driving force of delta function type we intend to do it next year.

## Acknowledgements

First and foremost we would like to thank Dr. Hayden and the entire Faculty and staff of the ONR program for all of the help, facilities, and encouragement provided for our research. We would especially like to thank Dr. Choudhury for all of the time, patience, and knowledge that he has shared with us.

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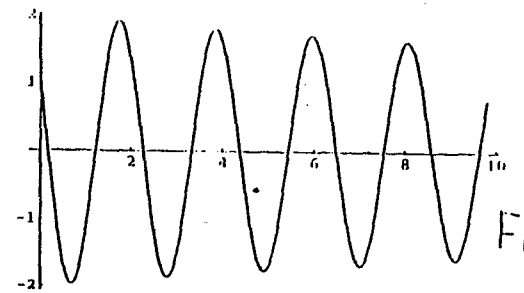



Fig. 1

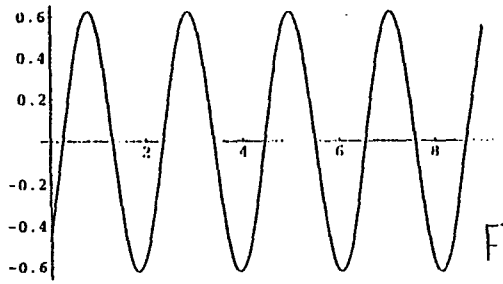



Fig. 2

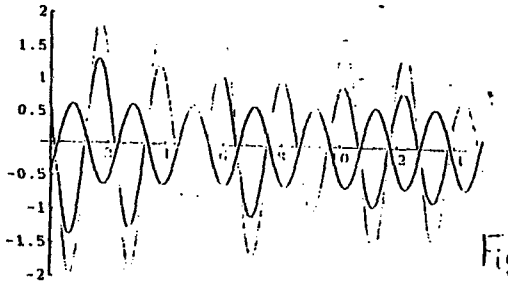



Fig. 3

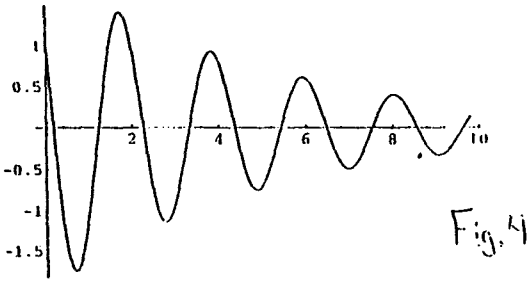



Fig. 4

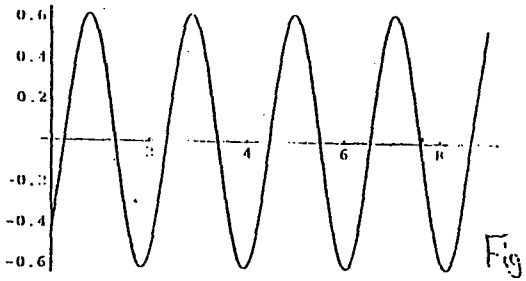



Fig. 5

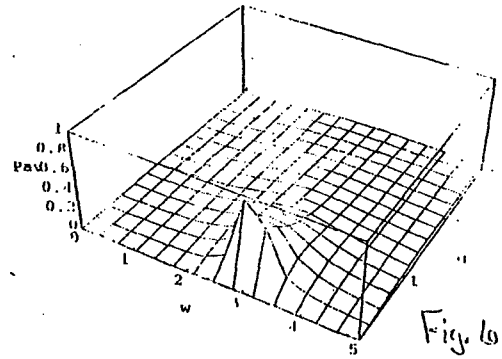



Fig. 6

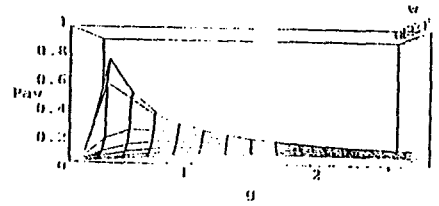



Fig. 7

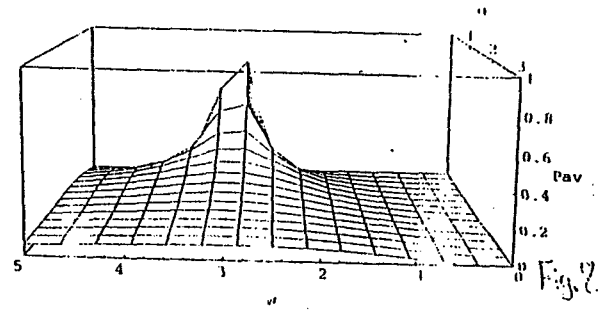
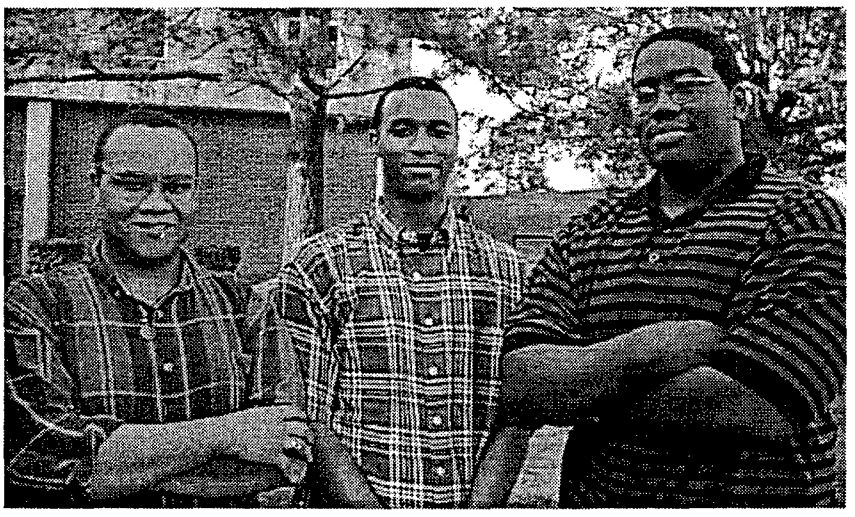



Fig. 8

# Multimedia Authoring

*Team Mentor: Amie Aydlett*



*Team Members: Je'aime Powell, Donald Charity, and Jonathan Williams*

# Multimedia Team Final Research Report

The goals of the 1997-1998 Multimedia Team was to learn the software from Macromedia entitled Authorware, and after mastering its concepts, organize, create, and produce a presentation that would educate others on what and how Authorware does.

During the beginning of the research, the members of the team first began to educate and teach themselves the application software. All members of the research group were given copies of the Authorware Working Model Guide Book. Each member began using the tutorial compact disc enclosed with the guide. During the first three lessons, all members worked together on learning the basic principals. The next six lessons were then divided up evenly upon the three members of the team. upon each consecutive meeting thereof, each member presented their learnings, which was saved on disk, to each of the other members and taught their assigned lesson to them.

Also during this time, the group was taken to the United States Coast guard base in Elizabeth City, North Carolina where the personnel showed the group some of their outstanding educational presentations and beneficial creations. They also stored one of their files on a disk for the group to use to give them additional assistance in creating their projects.

During the next few weeks, members of the team were assigned various tasks which included the main presentation, which was split into two parts, the team homepage, the research report, and the team articles reviews.

Developing the presentation portion of the research at one point was a problem. This was because of the limitations of the version of Authorware that each researcher was equipped with. After our advisor provided us with a full upgrade version of the program, the presentation was able to be completed in an easy fashion, even though the transition of the old files and incorporating them into the newer one was a bit of a hindrance.

The creation of the homepage was a relatively simple project as the team's knowledge of HTML assisted greatly to developing it. The articles were read and summaries were provided in a matter of days. The typographical errors were corrected and have been resubmitted in their final form.

The final research report was produced after the completion of all the team's research. It extensively covered all work done by the team. The team's final assignment which has been completed but not presented is their presentation to the students, faculty, and guests entitled "Authorware: From Us, To You" which is a formal presentation of the team's work on Authorware. At this session, each student will be provided with a disk containing a shocked version of the team's presentation which can be played on any Internet browser including Netscape Navigator and Microsoft Internet Explorer. This concluded the Multimedia's Team research and assignments that were to be completed during the 1997-1998 ECSU school year.

April 7, 1998

pg. 34-36

# The Web Is In Motion - On-Line Multimedia Is Limited, But Not For Long

by George Kepper

Multimedia Producer

In this article reviewed by the Multimedia Team, the author describes in a very in detailed discussion the progress that the multimedia is making with the Internet. It overally attempts to display the progress the Internet has made from a static web page to a page full of multimedia content including animation, audio, and video.

At this time, software and hardware are being developed in order to accomplish this long term goal. Bandwidth limitation was a problem at once, but now most network users are at ISDN, T1, and T3 connection speeds. and home users now have the 56Kbps option available. Arrangements are now being made with television stations, satellite operators, and various companies in order to aid this task.

Multimedia applications minimally require an Internet connection of 14.4Kbps. In addition, users must have the proper hardware and software to support the rich multimedia content such as particular video and audio cards, and a capable operating system such as Windows 95 and above or Macintosh operating system 7.5.3 or above. They also need suitable browsers such as Netscape Navigator 2.0 and above or Microsoft Internet Explorer (MSIE) 3.0 and above. Both browsers are now well prepared for such content with version 4.05 for Netscape, which was released on April 2, and version 5.02 for MSIE, which was released on March 29. Most of these browsers use helper application to play such multimedia content. One such application is RealAudio, which now goes by the name of RealPlayer. This application is capable of playing streaming Internet audio and video over ordinary phones and cable lines at supporting speeds as low as 14.4Kbps. Now even users who can not afford such costly modems can enjoy the same benefits as others. Another such type of helper application is Macromedia Shockwave, which like the RealPlayer, allows the user to listen, play, and rewind without waiting for downloads. This type of content only gets the header or the first part of the file and downloads the rest while the earlier portion is playing using the user's RAM and cache memory. This breakthrough makes it possible to have live video and audio conversation with another users or watch a live telecast from those providers that use it such as CNN and C-SPAN.

One type of animation that does not rely on helper applications is he moving GIF. This type, also called GIF89, allows the multi-image frames to be stored as a single GIF file. This technique is much simpler than using the push and pull technique of CGI to gather information. This form of animation is becoming more and more popular because it does not require that the user have anything other than the standard capable browser.

The final topic Kepper covers is Java. Java is a type of animation which incorporates the technology for real time animation as the data can be delivered live such as with stock tickers and global news. Java applets can be easily displayed through a Java-enabled browser such as those previously stated. This language is advancing even

more with Javascript which is more HTML based. This can provide information using cookies and even a fading color background upon the entrance of a web document.

## A Tale of the Tape

### When mining vaults yields unpleasant surprises.

Dan Daley

Television has a become the heaven of old nostalgic video clips and shows. The only problem with this is the fact that magnetic tapes and films become less pleasing with every use. Deterioration from usage or storage has some terrible effects on the quality of a tape. Historical or periodical tapes can become unusable due to the quality losses. Heat and Humidity are responsible for most of the problems with archived analog tape. A climate controlled vault-preferably with Fahrenheit temperature in the 60s and a humidity level below 50 percent is ideal, but historically, most analog tape has not been stored in these conditions. Bill Creed, video editor of a documentary about Lyndon Johnson that recently aired on England's Channel Four and on The History Channel in the United States, says although the staff at the National Archives in Washington did their best to make hundreds of hours of LBJ recordings audible, they could go only so far. Creed said they had to choose what was audible from the notes of LBJ's secretary from a Dictaphone rather than best. Things that were seen as very important were sent out to be improved using EQ and digital enhancement. Lou Gonzales, an engineer and owner of Quad Recording in New York City, dealt several years ago with neglected recordings for a major project. Some John Lennon recordings he had received had been stored for years in a humid unairconditioned environment. In cases such as this, the binder (the glue that holds the oxide tape formulation to the backing material) turns into a molasses like substance and sometimes takes the program material with it. Gonzales devised a technique in which a sponge-like cloth positioned before the

playback heads wiped the tape clean of excess goop. It was a painstaking process with many starts and stops but it was the only way to retrieve the music.

Another solution for fixing the binder is to bake the tape, a common technique in which older analog tapes are placed in a convection oven for 24 hours and heated at Fahrenheit temperature in the low 100s. The process will resolidify the binder, but "what you have to do is make a copy of that tape very quickly," Gonzales says. "Otherwise, the baking process will unleash other degradation and you could lose the tape altogether."

Several companies, including Sonic Solutions and CEDAR Audio, manufacture hard-disk-based systems that use electronic recomposition to eliminate or reduce certain types of problems often found on older and improperly stored analog and digital tapes. Functions such as declicking, decrakling and dehissing have become major elements of restoring analog audio, particularly vinyl records. The disk-based systems analyze pops, clicks and scratches, and use algorithms that interpolate and replace missing data from program material.

Although these techniques help some what in retrieving archival information of the past many historical recordings are still lost forever. DVD technology will hopefully stop the loss of records form happening again. This new technology is laser driven as well as a lot easier to store. Hopefully these new recordings will last for all time.

## Executive Animation

Author: Claudyne Wilder

Video & Multimedia Producer, April 1997, p. 37

Have you recently given a presentation created by a colleague or friend which looks great but just isn't in sync with what you really wanted, or have you personally ever done a presentation which you later found took away form the speaker mare than helped him/her? Perhaps you didn't follow the ten essential rules of presentation creation. These rules were created by the Author of the story 'Executive Animation' in the April edition of Video and Multimedia Producer, Claudyne Wilder. She had recently worked with an executive who had just received some screens of presentation created for his big meeting. He wanted help with his presentation style and dramatic delivery. Along the course of the session it was found that the presentation itself was at fault in making him feel out of place. The author then had to revamp the presentation causing the company to loose money and development time. The author explains the down time wasn't as much a problem but the fact that it all could have been avoided by having the presentation creator to be included. After this event she created some basic rules for the problem to not happen again. The basic rules are:

1. **Match the styles of the presenter and the presentation.** - The first thing you need is the presenters presenting style. Is his or her style conservative or moderate? Enthusiastic? Animated? You don't want to put together a bells and

whistles talk with sound, animation and lots of wild movement when the person will be sitting reading a script.

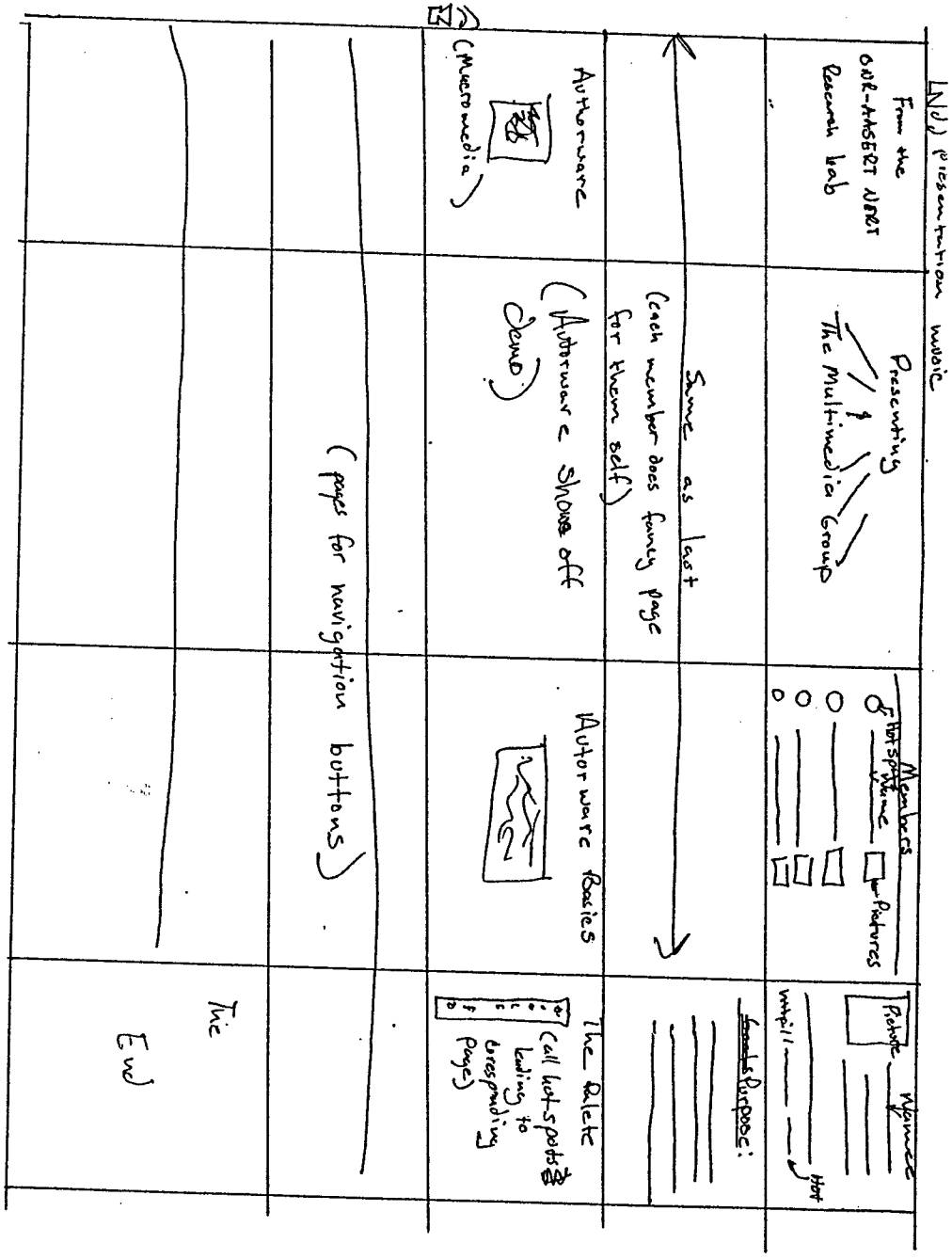
2. **Avoid Scripts.** - First, a script anchors the presenter to one spot and can hamper his or her ability to sound animated. Second, scripts can keep presenters from establishing rapport with the audience. Instead of scripts, designing the screens as cue cards is suggested.

3. **Involve the presenter early in the process.** - If you involve the presenter early the presenter will both be more comfortable and animated in the presentation when giving it.

4. **Make the visuals self explanatory.** - Unusual visuals will loose the audience.

5. **Use headings to cue the speaker.** - The heading should contain the screens main point, serving as a cue to the speaker as soon as the screen appears. Get to know the presenter, if possible, and talk to him or her. - This adds the character of the speaker to the presentation.

Remember that you have the power to make a presenter truly compelling or truly boring. Take the time and energy to make your presenter look outstanding.



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pp. 47-52

# Breaking Through Into VR

By: Louis M. Brill

Multimedia Producer

In the article reviewed by the Multimedia Team, "The Whole New World" the author compares the advances of multimedia to the advances of virtual reality (VR). Multimedia businesses are now using the same equipment virtual reality businesses are using to create their presentations. Also multimedia developers are now becoming more familiar with virtual reality applications and incorporating them into their own developments. The user buying the multimedia package is gaining more than multimedia but they are also gaining a more interactive package as an virtual reality application. With the equipment multimedia developers are using today; they will be able to develop their own VR experience. Virtual reality creates the effect of objects being there but not actually. Combined with multimedia, VR gives an extra edge to the user, it draws them closer and causes them to become more involved in the presentation. Even though multimedia and VR can be incorporated together presenting the same features, they also differ in the same instance. In multimedia the information is presented by text, graphics, and sound. Virtual reality on the other hand is presented in 3-D format, shapes, and sound using no traditional tools to guide the user through the application. Also in virtual reality all the projects completed are strictly experimental. In today's VR development market, the developers are asking how best to use the technology. In making a transition to VR, comes the question of how will they gain funding for the upgrade and how will they train the developers to use the new equipment.

In conclusion, the future of virtual reality is here today, applications of VR have been adapted in commercial, scientific, and industrial communities. In today's society people do not just look at media anymore they want to interact with it, this is one of the advantages that virtual reality presents to the user. This calls for more training for the users. Because of the users of multimedia desire to touch and move things, virtual reality and multimedia will converge together towards the future.

# JavaScript

*Team Mentor: Dr. K. Kalkarnie*

*Team Members:* *Angela Mizelle*
*Lakisha Mundon*
*Sheri Joyner*
*Micheal Boisson*
*Joseph Gale*

# HTML/JavaScript Team


## Abstract

Student HTML/JavaScript researchers learn to produce documents in Hyper Text Markup Language (HTML), the language used to create web pages. Specifically, they will explore the following topics:

Introduction to the World Wide Web; the structure HTML pages - tags, head, title, body, end tags; headings; text enhancing - bold, underline, italics; paragraphs; lists; links; images; tables; background and text color; frames; windows; introduction to JavaScript

The student researchers will explore the above topics in a step by step manner. At the end of their training, they will be able to update and maintain ONR/NERT web pages.


## Implementation

The training started with HTML and culminated with an introduction to JavaScript. Some members of the team did not have much prior experience with programming. Hence, during the first semester, their training involved with a cycle of a session of lecture exploring some HTML topics and a session on hands on experience with the computer exploring the concepts learnt. Most of the second semester was used for learning the concepts and independently carrying out the hands on experience and also going throug the HTML tutorials on the Internet. In their training, they explored specifically the following topics:

The world Wide Web; web browsers; Internet domain extensions; Structure of HTML pages - tags, end tags, head, title, body; A simple web page; Paragraphs; Text formatting - headings, horizontal rule, bold, underline, line breaks, pre-formatted text, the dreaded blink; Lists - ordered lists, unordered lists, definition lists, menu lists, directory lists, nested lists; Links - linking local pages using relative and absolute path names, links to documents on the Web, links to specific places within the same document; Tables - creating basic tables: rows, cells, and captions, table and cell alignments; Images - inline images, text and image alignments, images and links; Changing the background and text color; Frames; Windows; Introduction to JavaScript - What is JavaScript; JavaScript and HTML; Uses of JavaScript - including dynamic information, validating forms, and making the web pages interactive; A simple JavaScript program; Objects and functions; A JavaScript program to print tables

```
<!Presented by Angela Mizelle
On this page the following items are being presented
        1.  The defintion of frames
        2.  How frames are used
        3.  An example of frames
!>

Frames

When using frames you divide Web pages into multiple, scrollable
regions.  You can present information in a flexible and useful fashion.
Each region has different features such as:

        a.  It can be given an indivdual URL, so it can load information independent
            of the other frames on  the page;
        b.  It can be given a NAME, allowing it to be targeted by other URLs;
        c.  It can resized dynamically if the user changes the window's size.

A Frame document has a basic structure, except the body container is replaced by
a frameset container which describes the sub-HTML documents, or frames, that will
make up a page.  Tags that would normally be placed in the body container can not
be placed in the frameset tag, or the frameset will be ignored.  The framese tag
has a matching end tag, and within the frameset you can only have nested frameset
tags, frame tags, or the noframes tag.

Targeting windows allows the document writer to assign names to specific windows, and t
documents to always appear in the window bearing the matching name.

A name is assigned to a window in several ways such as:

        a.  A document can be sent with the optional HTTP header
        b.  A document can be accessed from a targeted link.  In this case there
            is actual HTML which assigns a target window_name to a link.
        c.  A window created within a frameset can be named using the NAME attribute
            to the frame  tag.



Targeting with HTML is accomplished by means of the target attribute.  This attribute
can be added to a varitey of HTML tags to target the links referred to by the
tag.  The attribute is of the form:
TARGET="window_name"


An example of frames is presented below.

<html>
<head>
<title>Angela3.html</title>
</head>

<frameset cols="25%,*" frameborder = no border = "0" framespacing = 0>
<frame src="angela1.html" scrolling="yes" name="left" frameborder = no border =
"0">

<frameset rows="25%,*" frameborder = no border = "0" framespacing = 0>
<frame src="angela.html" scrolling="yes" name="top" frameborder = no border =
"0" framespacing = 0>
<frame src="angela2.html" scrolling="yes" name="right" frameborder = no border =
 "0" framespacing = 0>

</frameset>

</html>

The outcome of this example of frames would be three frames presented on one page.
```

LINKS

A link is used to retrieve the location of a file.
The link tag appears within the head section of a document.
Links can be used for:

1.Links to other pages
(link to profile from resume4 and back)
2.Links to other parts of the current page *
(link to a particular section of the same page and back to top)
3.Links to images and pictures
(link to PIC.HTML)
4.*Links to soundfiles

Links consist of a tag, a parameter, a the value.The code for the link is put wherever you want the link to show up. The link has a symbol, a section of text or a picture that a viewer can select(click on) in a web page to activate the link. The value is the address of the site you are making the link to. If you are using a link to another section in the same page, then you must put an Anchor at the top of the section you want to make the link to.

ANCHORS

Anchors are used in links to other areas of the same page only. There are two parts to an anchor. One part is specifying the area that will be linked to, and the other is the link itself.

(The anchor tag defines either a link or an anchor in a document.) The anchor tag must contain an HREF attribute.The link must use a #(go to jot), The code for the link to another section is also put wherever you want the link to show up.

TABLES

Tables are simmilar to ordered and unordered lists. Tables are simple because they only use four tags:

1.Table Heading <TH>
2.Table Row <TR>
3.Table Coloumns<TC>
4.Table Data <TD>

The table heading is basically the same as the regular heading command. The table row resembles the list item in an ordered list. Listed horizantally. Table coloumns are listed vertically. Table data is the text inserted in the rows and coloumns.

An example of Links, Anchors, and Tables are below.
-RESUME5.HTML
-TABLES.HTML

---

```
<! JOSEPH GALE
IN THIS RESUME WE INCORPORATED:
        1. LINKS TO SPECIFIC SECTIONS OF THIS PAGE
        2. LINKS BACK TO THE TOP OF THE PAGE
        3. LINKS TO OTHER HTML FILES
        4. ANCHORS FOR LINKS FROM PROFILE FOR
         SPECIFIC SECTIONS OF THIS PAGE
        5. ORDERED AND UNORDERED LIST
        6. VARIED TYPES
!>

<html>
<head>
<title>resume of Joseph Andrew Gale</title>
</head>
<body>
<body bgcolor=gold>
<A NAME="TOP"></A>
<h1>Joseph Andrew Gale</h1>
<A HREF="pic.gif">CLICK HERE FOR PICTURE</A>
<h3>ADDRESSES</h3>
<PRE>
      SCHOOL:                                                    HOME:
ECSU CAMPUS BOX #693                                     4526 GUADALAJARA DR.
ELIZABETH CITY STATE UNIV.                               SAN ANTONIO, TX.78233
ELIZABETH CITY, NC.27909
</PRE>
<OL>
<LI><H3><A HREF="#EMAIL">E-MAIL ADDRESSES</A></H3>
<LI><H3><A HREF="#PROFILE">PROFILE</A></H3>
<LI><H3><A HREF="#EDUCATIONAL">EDUCATIONAL EXPERIENCE</A></H3>
<LI><H3><A HREF="#ADVANCED">ADVANCED PROGRAMS</A></H3>
<LI><H3><A HREF="#ORGANIZATIONS">ORGANIZATIONS</A></H3>
<LI><H3><A HREF="#HOBBIES">HOBBIES</A></H3>
<LI><H3><A HREF="#INTEREST">INTEREST</A></H3>
<LI><H3><A HREF="#GOALS">GOALS &EXPECTATIONS</A></H3>
</OL>
<H3><A NAME = "EMAIL"</A>E-MAIL ADDRESSES</H3>
<OL>
<LI>j_gale@hotmail.com
<LI>j_gale@rocketmail.com
<LI>jgale@umfort.cs.ecsu.edu
</OL>
<A HREF="#TOP">CLICK HERE TO GO TO TOP</A>
<H3><A NAME="PROFILE"></A>PROFILE</H3>
<UL TYPE = DISC>
<LI>PARENTS: DEBORAH Y. GALE & MIKE E. GALE
<LI>BIRTHDATE: JANUARY 8,1979
<LI>HEIGHT:6'1"
<LI>WEIGHT:170LBS.
<LI>ETHNIC: AFRICAN-AMERICAN
<LI>MARITAL STATUS:VERY SINGLE
</UL>
<A HREF="#TOP">CLICK HERE TO GO TO TOP</A>
<A NAME="EDUCATIONAL"></A><H3>EDUCATIONAL EXPERIENCE</H3>
HIGH SCHOOL DIPLOMA FROM DOUGLAS MACARTHUR HIGH SCHOOL<br>
CURRENTLY A FRESHMAN AT ELIZABETH CITY STATE UNIVERSITY<br>
<A HREF="#TOP">CLICK HERE TO GO TO TOP</A>
<A NAME="ADVANCED"></A><H3>ADVANCED PROGRAMS</H3>
<OL TYPE = I>
<LI>HONORS PROGRAM
<LI>NASA-ONR RESCEARCHERS PROGRAM
</OL>
<A HREF="#TOP">CLICK HERE TO GO TO TOP</A>
<A NAME="ORGANIZATIONS"></A><H3>ORGANIZATIONS</H3>
<OL>
<LI>TOP TEENS OF AMERICA
        <UL>
        <LI>ADMINISTRATIVE ASSITANT
        <LI>CHAIRMAN OF BEAUTIFICATION
        </UL>
<LI>NAACP
        <UL>
        <LI>CO-CHAIRMAN OF MEMBERSHIP
        </UL>
<LI>MARANATHA BAPTIST CHURCH
        <UL>
        <LI>YOUTH MINISTRIES
```

```
    </UL>
</OL>
<A HREF="#TOP">CLICK HERE TO GO TO TOP</A>
<A NAME="HOBBIES"></A><H3>HOBBIES</H3>
<UL TYPE = SQUARE>
<LI>BASKETBALL
<LI>ALL MUSIC
<LI>COMPUTERS
</UL>
<A HREF="#TOP">CLICK HERE TO GO TO TOP</A>
<A NAME="INTEREST"></A><H3>INTERESTS</H3>
<UL>
<LI>BASKETBALL
<LI>ALL KINDS OF MUSIC
<LI>COMPUTERS
<LI>MOTORCYCLES
<LI>MOVIES
</UL>
<A HREF="#TOP">CLICK HERE TO GO TO TOP</A>
<A NAME="GOALS"></A><H3>GOALS & EXPECTATIONS</H3>
BACHELORS DEGREE IN COMPUTER SCIENCE<br>
MASTERS DEGREE IN COMPUTER ENGINEERING<br>
CAREER IN COMPUTER ENGINEERING FEILD AT NASA<br>
<A HREF="#TOP">CLICK HERE TO GO TO TOP</A><BR>
<A HREF ="PROFILE.HTML">CLICK HERE FOR PROFILE</A><BR>
<A HREF ="TABLE.HTML">CLICK HERE FOR TABLE</A>
</BODY>
</HTML>
```

---

```
<!Joesph Gale
IN THIS PAGE WE INCORPORATED:
        1. TABLES
        2. CAPTIONS
        3. BACKGROUND COLOR!>

<html>
<body bgcolor=white>
<CENTER>
<TABLE>
<caption><H1><blink><b>#CAMPUS NUMBERS#</b></blink></H1></CAPTION>
<TR>
<TH ALIGN ="LEFT">NAME</TH>
<TH ALIGN ="RIGHT">TELEPHONE</TH>
</TR>
<TR>
<TD>JOEY</TD>
<TD>8531</TD>
</TR>
<TR>
<TD>ANGELA</TD>
<TD>8432</TD>
</TR>
<TR>
<TD>ALBERT & GREG</TD>
<TD>8527</TD>
</TR>
<TD>CANDACE & DONISE</TD>
<TD>8402</TD>
</TR>
<TD>DEANNA</TD>
<TD>8427</TD>
</TR>
<TR>
<TD>KIZZY</TD>
<TD>8437</TD>
</TR>
<TR>
<TD>KEISHA</TD>
<TD>8424</TD>
</TR>
<TR>
<TD>DARNELL</TD>
<TD>8515</TD>
</TR>
<TR>
<TD>YETTA</TD>
<TD>8776</TD>
</TR>
<TR>
<TD>MARLON</TD>
<TD>8754</TD>
</TR>
<TR>
<TD>AYONDA</TD>
<TD>8740</TD>
</TR>
<TD>JASON</TD>
<TD>7157</TD>
</TR>

</TABLE>
</CENTER>
```

*Nurturing ECSU Research Talent (NERT) Program*
Sponsored by
Elizabeth City State University
Office of Naval Research

**Thursday April 2, 1998 5:00 pm 116 LH**

FRACTALS & CHAOS
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ONR Final Research Team Reports

**Tuesday April 7, 1998 5:00 pm 116 LH**

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# ATM Networks


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# *SYSTEM ADMINISTRATION TEAM*
# *1997-98 FINAL REPORT*
# *April 9, 1998*

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### 1. Firewall

A firewall is a system or group of systems that enforces an access control policy between two networks. The firewall can be thought of as a pair of mechanisms: one which exists to block traffic, and the other which exists to permit traffic. Some firewalls place a greater emphasis on blocking traffic while others emphasize permitting traffic. The most important thing to recognize about a firewall is that it implements an access control policy. The purpose of firewalls are to:

- restrict people to entering at a carefully controlled point
- prevent attackers from getting close to your other defenses
- restrict people to leaving at a carefully controlled point

A firewall is most often installed at the point where your internal network connects to the Internet. All traffic coming from the Internet or going out from your internal network passes through the firewall. Because the firewall authorizes data exchange between the Internet and the network, it is the enforcer of the security policies of the site.

There are three major types of firewall architectures: Dual-Homed Host, Screened Host, and Screened Subnet.

The dual-homed host architecture is built around the dual-homed host computer, a computer which has at least two network interfaces. Such a host could act as a router between the networks these interfaces are attached to; it is capable of routing IP packets from one network to another. However, to implement a dual-homed host type of firewalls architecture, you disable this routing function. IP packets from a network (e.g., the Internet) are not directly routed to another network (e.g., the internal, protected network). Systems inside the firewall can communicate with the dual-homed host, and systems outside the firewall (on the Internet) can communicate with the dual-homed host, but these systems can't communicate directly with each other. IP traffic between them is completely blocked. This architecture, the dual-homed host firewall, is pretty simple: the dual-homed host sits between, and is connected to, the Internet and the internal network.

packet is actually talking to or where it actually came from. Network level firewalls tend to be very fast and tend to be very transparent to users.

2.) Application level firewalls generally are hosts running proxy servers, which permit no traffic directly between networks, and which perform elaborate logging and auditing of traffic passing through them. Application level firewalls can be used as network address translators, since traffic goes in one "side" and out the other, after having passed through an application that effectively masks the origin of the initiating connection. Application level firewalls tend to provide more detailed audit reports and tend to enforce more conservative security models than network level firewalls.

**Three Functions**

*1. Packet Filtering*

The packet filters are a basic level of security using complex tables that indicate what communication protocols are allowed into and out of a particular network. These provide some security, but the filters still do not keep hackers out of the system. Packet filters are often implemented in routers throughout the Internet. In firewalls, packet filters are usually combined with one or both of the following mechanisms.

*2. Circuit-Level Gateways*

Circuit-level gateways are also known as "proxies". The purpose of a proxy is to hide information about the network by making connections through the firewall appear to the remote user as if they are originating from the firewall itself. Proxies can be visible or invisible to the remote user, but they always act as a go-between from one computer or network to another.

*3. Application Gateways*

An application gateway may be thought of as an application that secures another application. This type of gateway "accepts the connection, typically performs strong authentication on the user which often requires one-time passwords, and then often prompts the user for information on what host to connect to." Application gateways are inefficient, since they require a filter for each application. However, they are also much more secure because they authenticate users and limit the damage that can be done to a network.



**2. Network Security**

What are the different ways to secure your network?

In everyday life, the amount of stress placed on a Network Administrator to protect his network from harm has become a difficult task. An administrator job is to rid the network of all threats affecting the network. A threat can be described as anything or anyone that has motivation to attempt to gain unauthorized access to your network or could also be an authorized person with intent to gain access to an unauthorized area. The motivation of the intruder is to create havoc on the network or benefit by gaining access to something that is not allowed to him/her.

There are ways to help secure one's network besides firewalls. Even though firewalls are needed, there are software packages used to compliment the firewalls. Software packages such as Pingware, Internet Scanner, NetProbe, and SATAN are a few that assist the firewalls.

Pingware has graphical interfaces which simplifies operations as well as reporting tools that are easy to use. It also has unrestricted scanning abilities which make it economical for use across large enterprises. Pingware weakness lies in its vulnerability coverage which is limited.

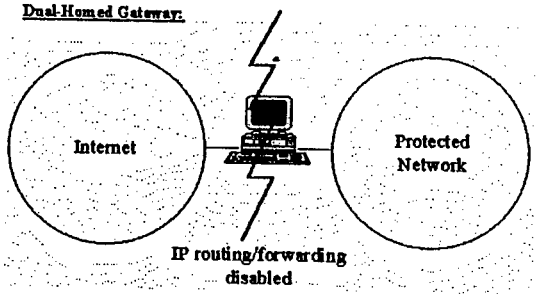
Internet Scanner provides an extensive list of vulnerability tests with an easy-to-use interface. It also generates available network services inventory reports and can audit firewalls as well as Windows systems. Internet Scanner has its weaknesses, its invasive features could create havoc on an entire network.

NetProbe is good for creating comprehensive lists of known security holes using a menu-driven interface. It also provides easy to understand reports with informative hypertext-based links. NetProbe is unable to detect NFS flaws and it's reports provide extremely limited inventory information.

The software known as SATAN is freeware that checks for many common security holes and it easily operates with any hypertext Web browser. The weaknesses of SATAN are it lacks official technical support, it only detects a limited number of network vulnerabilities, and it is difficult to install because it requires a C compiler and Perl 5.

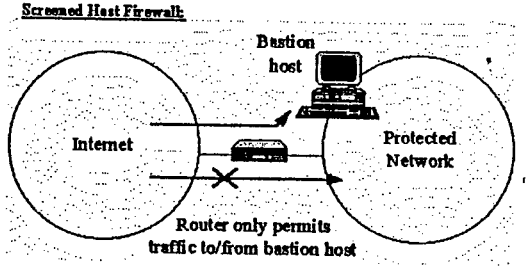
The PC Week Labs recommends Internet Scanner for it's superior breadth of coverage and ease of operation. Pingware performs well but is short on features while NetProbe offers an acceptable range of scans but is weak in reporting. And SATAN maybe free, but its lack of support and difficulty of operation make it impractical for enterprise use.

Dual-Homed Gateway:




While a dual-homed host architecture provides services from a host that's attached to multiple networks, a screened host architecture provides services from a host that's attached to only the internal network, using a separate router. Packet filtering provides the primary security in this architecture. The bastion host sits on the internal network. Due to the setup of the packet filtering on the screening router, the bastion host is the only system on the internal network that hosts on the Internet can open connections to. Any external system has to connect to the host if they are trying to acess the internal network.

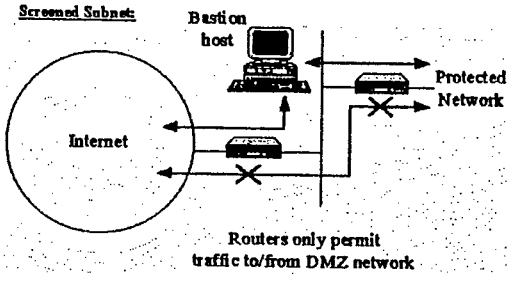
Screened Host Firewall:




The screened subnet architecture adds an extra layer of security to the screened host architecture by adding a perimeter network that further isolates the internal network from the Internet. They are safer than the screened host because the host on the screened subnet does not sit on the internal network.



Screened Subnet:




In conclusion, a firewall is any device which filters data and access to a protected network. Many companies need their network to store confidential and public information. Without a firewall, the network is vulnerable to any types of intrusions. More elaborate firewalls block traffic from the outside to the inside, but permit users on the inside to communicate freely with the outside. There is no single mechanism that will provide total protection for a network but some type of protection is better than no protection at all.

**Design Decisions**

There are a number of basic design issues that should be addressed by the person who has been tasked with the responsibility of designing, specifying, and implementing or overseeing the installation of a firewall.

1.) The first and most important reflects the policy of how the company or organization wants to operate the system: is the firewall in place to explicitly deny all services except those critical to the mission of connecting to the net, or is the firewall in place to provide a metered and audited method of "queuing" access in a non-threatening manner.

2.) The second is at what level of monitoring, redundancy, and control does one want?

3.) The third issue is financial.

**Types of Firewalls**

1.) Network level firewalls make their decisions based on the source, destination addresses, and ports in individual IP packets. A simple router is the "traditional" network level firewall, since it is not able to make particularly sophisticated decisions about what a

Each software package can be used to test a firewall to supply the network with optimal security. There aren't any packages that are without some faults, but it is up to the system administrator to decide which package is best suitable for their network protection.

## 3. Articles Summaries for Network Security

***"Dynamic Virtual Private Networks :Security Mechanisms and Methods"***
**by: TradeWave Cyber Company**

This article is mainly about how a network security system consists of a set of control points which work together to form a integrated security package. A control point is a tool or process implemented to meet a specific threat. TradeWave, which is a ideal partner for providing Internet security solutions have established that VPNs (Virtual Private Network) should be installed to provide access of information and allow diversity of range and communication.

Encryption Mechanisms and Standards

Other types of security are private-key and public-key security. Private-key security is symmetric, in where the client and the server share a key to encrypt and decrypt information on a network. Public-key security is an asymmetric mechanism used for distributing encryption keys that are used to lock and unlock data across an unsecured path. The main advantage offered by public-key technology is increased security. It is also more suitable for intranets for three reasons: 1) more scalable to very large systems with millions of users, 2) more flexible means of authentication, and 3) it can support digital signatures.

Access Control Lists

An access control lists determines who is given access to a local or remote computer system or network, as well as what and how much information someone can receive. This method is used for specifying access for both certain users and certain groups of users. In addition, access control mechanisms can be distributed on the network. This allows multiple websites access to use the same control mechanisms.

Routers, Firewalls, and Encrypted Routers

This particular section of the article defines what a router and a firewall is and how it can be used to support a VPN. Routers are computers that control traffic on a network, and a firewall is a collection of components that supervises all traffic in and out of a network permitting only traffic which is authorized by local security policy to pass. A VPN based on routers and firewalls can be constructed for within-network and network-



network traffic. By using this method, protection of one network from another and blocking traffic from an unauthorized user is available when combining the two.

In essence, TradeWave believes that VPN's are very essential in the completion of having a dynamic network security. Having this resource establishes trust in open environments and accommodation of information needs for intranets and Internet technology. Therefore, a network security system built on these principles are reported to have a better method of control within the networking system.

***"Internet Connectivity and Security Services White Paper"***
**by: The Root Group**

This paper discussed the importance of security of networking. It presents an overview of three possible Internet connectivity solutions with varying security levels.

Reliable, Secure and Powerful Internet Connections

A successful Internet connection must integrate the following features:

*Reliability*: Once an Internet connection is in place, it should be available at all times, and be easily manageable and upgradable with minimal interference.

*Security*: The site's Internet connection must be secured in order to ensure that data integrity of a site will not be compromised.

*Powerful information access*: An Internet connection is as useful as the information based tool sets installed on the network to take advantage of it.

*Hardware and software integration*: The choice of hardware platforms linking one's network(s) with the Internet is an important one, as some non-standard platforms might dictate lengthy installation and future support times.

Secure Internet Connectivity Issues

Secure Internet connectivity requires that one or more of the following mechanisms to be in place between the various networking and application equipment:

*Authorization mechanisms*: Restricting the type of connection that can exist severely limits unauthorized access.

*Authentication mechanisms*: Typical password-protected access on the low-end, to one-time generated passwords involving hardware mechanisms on the high-end, ensure that authorized users are indeed the ones involved in the connection.

*Encryption mechanisms*: Traveling information is much harder to read if it is encrypted.

*Security monitoring mechanisms*: A less secure connection whose unauthorized use is quickly detected can be controlled and dealt with.

*Incident alert policies*: Unauthorized access can be eliminated when it is detected and when the right set of actions are taken against a potential intruder.

Three Secure Internet Connectivity Solutions

*Basic Connectivity Solution*

This solution involves a bastion host acting as a router and a firewall between the internal network and the Internet.

*Intermediate Connectivity Solution*

Connectivity is controlled and secured both at the router and on the bastion host where a suite of security tools and security software control and ensure safe operation.

*High-end Connectivity Solution*

Two routers stand between the internal network and the Internet.

***"INS Unveils Comprehensive Network Security Services Program"***
**http://www.ins.com/press/ntwk_svcs_pr.html**

International Network Services (INS) located in Sunnyvale, CA offers a comprehensive set of consulting services to help clients address the complex security issues associated with enterprise networking and internet deployment. The INS covers the entire range of network security concerns, including network perimeter penetration, remote access management and control, host and LAN security, and Internet/Intranet issues. INS provides fully automated testing of World Wide Web servers, firewalls, host systems, servers, and IP clients using leading tools, such as Internet Security Systems' (ISS) SAFEsuite 4.0 package. This package was also selected by the National Computer Security Association (NCSA) as its benchmark for firewall certification.

The article goes through and answers various question dealing with network securities such as what specific network security areas INS address, what network security tools they use, and a few others. INS network security services focus on the



following key elements: Remote Access/Perimeter Security, Host/LAN Security, and Internet/Intranet Security.

Remote Access/Perimeter Security includes "defining the boundaries of the enterprise network, and identifying the kind, number, and placement of paths into and out of the enterprise network. These paths may include permanent and switched routed data services and analog or ISDN dial in/out services. Focus from a client perspective is firewall security and dial-in controls to protect the enterprise systems and data."

Host/LAN Security involves "steps taken to protect a specific system family from internal and external attacks. The primary platform focus is BSD and SVR4 UNIX, Windows NT, Windows 95, and Novell NetWare.

Internet/Intranet Security "presents the most complex security environment since a strong security program must contend with the increased threat created by endusers connecting to a public data network. The INS service program also addresses Intranet security issues, such as external access to sensitive corporate data and safeguards to protect proprietary information.

INS developed a six-part network security program consisting of:

1. Internet/Intranet Requirements & Security Policy Development
2. Perimeter Security Design
3. Firewall Implementation
4. Server & Workstation Security
5. Testing & Certification
6. Client Training & Knowledge Transfer

INS continues to address complex issues with security practice implementation and on-going network security troubleshooting.

## 4. Articles Summaries for Firewalls

***"Firewalling and Proxy Server HOWTO"***
**by Mark Grennan**

The article "Firewalling and Proxy Server HOWTO" by Mark Grennan is an update from David Rudder's (drig@execpc.com) original "Firewall-HOWTO" article. Mr. Grennan discusses firewalls, setting up a firewall, preparing the Linux system, IP filtering setup, installing TIS proxy server, and the SOCK proxy server as well as advanced

configurations. Grennan defines a firewall as a device that protects a private network from the public.

An IP filtering firewall works at the packet level where it controls the flow of packets. It can block people from accessing a private system but will not tell you who accessed your public system or internet from the inside. A filtering firewall is an absolute filter, it doesn't allow any outside access to a private system. A proxy server allows indirect internet access through a firewall and if configured correctly are completely secure.

The article also shows that Mark Grennan used a 486-DX66 computer with 16 meg of memory and a 500 meg Linux partition. It uses two network cards, one connected to a private LAN and the other to a LAN the called DMZ (de-militarized zone). The DMZ has a router with a connection to the internet. The rest of the article shows steps on how they prepared the Linux system, configured the network, and installed the servers.

***"Firewalls Are Not Enough"***

**by Frederick M. Avolio**

The article "Firewalls Are Not Enough", the author was concerned with people using a firewall as its only security resource. The author was not against the use of firewalls but they need help in order to keep your network secure. In order to have a very secure network, we must first establish some type of a network security perimeter. A security perimeter is established by a security policy, security policy enforcement mechanisms and methods; in which a firewall is considered as a mechanism.

There are four steps to take in order to have a successful network security system. They are a security policy, a risks analysis, a business needs analysis and identifying security mechanism and methods. They are all required but the order in which all are done is most important. The security policy is the first step to prevent tampering with your network by asking what are the threats to your network, what needs should be protected, and what is to be feared.

In the risks analysis stage, the vulnerabilities are identified, probabilities of the exploration of them are assessed, and countermeasures are identified and priced out for cost of effectiveness. Lacking a risk analysis will leave a group not knowing whether their security policy is feasible and having no way of knowing about its capability. Business needs require a document that includes what the service requirements are and a statement of what happens to the business if the services are interrupted. Mechanisms and methods are based on the security policy, the business needs, and counter perceived threats. In the network security perimeter, we may use security mechanisms and methods such as encryption of files, data transmission encryption, user authentication servers and tokens,



and inter-network firewalls. Once these factors have been implemented it must be reevaluated routinely and periodically.

***"Thinking About Firewalls"***

**by Marcus Ranum**

The author gives a brief definition of a firewall, helpful tips on designing a firewall and a brief description of different types of firewalls. The article explains that firewalls are used to keep intruders out of private networks and to keep unauthorized users from exporting certain data files. The author expresses that the firewall is mainly used against intruders gaining access through the internet, even though employees within the system may be a threat outside hosts are larger in number and usually carry a larger threat.

The author gives important tips on designing a firewall which include considering what type of environment you are in. You should ask yourself which is more important, security or ease-of-use. He gives a basic approach to answer the question: "That which is not expressly permitted is prohibited" or "That which is not expressly prohibited is permitted." The author also made the point that when designing a firewall, always create it to block everything and determine what or who should be allowed to enter.

The author described several types of a firewalls including screening routers, bastion host, dual homed gateways and screened host gateways. The screening router blocks traffic between networks or specific host. A Bastion host allows only a small number of services to communicate with it. The Dual Homed Gateway uses a Bastion host and allows no traffic directly between networks. Screened Host Gateway uses a combination of both a screening router and a Bastion host and is the most commonly used firewall configuration.

## Recommendations

Elizabeth City State University (ECSU) is implementing a bus topology network. In this topology, data traffic operates in parallel to automotive traffic. All the machines have paths that act like roads, leading to one main connection to the information superhighway. At this main connection, the dual-homed architecture would best protect the network. Data traffic cannot reach the Internet nor another machine on the network without being policed by the bastion host. Packet filtering provides the primary security in this architecture. The router only allows the bastion host to open connections to the Internet.

Any machine outside the network cannot connect to network without first passing through the router and the bastion host.

Since ECSU already has only one router that connects the network to the Internet, there is only a need for a machine to act as a bastion host. A high-end IBM PC with a LINUX operating system would be the most cost effective machine for the bastion host. The PC should have the latest version of LINUX and the software required to effectively perform packet filtering. All the machines on the network must be configured to ask the bastion host for permission to connect to the Internet. Any machine on the network that is not configured will not be able to see any other machine or the Internet. This configuration should provide effective protection to ECSU's network without having to purchase or change many devices on the network.

**EOSDIS: The Gateway To Earth Science Data Products and Services**

EOSDIS stands for the Earth Observing System Data and Information System. It is being designed as a distributed system to support archival and distribution of data at multiple data centers. The centers are connected by an Information Management System (IMS) which provides an interface for earth science data allowing users to search for and order data from multiple data centers in a single session.



**References**

1. "Network-1 Introduces FireWall/Plus 4.0 Industries Only Multi-Protocol Firewall Gains Enhanced Management, Performance And Security"
http://www.network-1.com/print/press1/fwp40pr.html

2. "Thinking About Firewalls" by Marcus Ranum
http://www.tis.com/docs/products/gauntlet/ThinkingFirewalls.html

3. "Firewalls: Your Network's Best Buddy" by Matt Raters
http://cord.iupui.edu/~mmrates/firewalls/index.html

4. "Internet Firewalls Frequently Asked Questions" by Marcus J. Ranum
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5. "The Rotherwick Firewall Resource"
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12. "INS Unveils Comprehensive Network Security Services Program"
http://www.ins.com/press/ntwk_svcs_pr.html

13. "Internet Connectivity and Security Services White Paper"
by: The Root Group
http://www.rootgroup.com/jwz/white_paper.html

14. "Dynamic Virtual Private Networks :Security Mechanisms and Methods"
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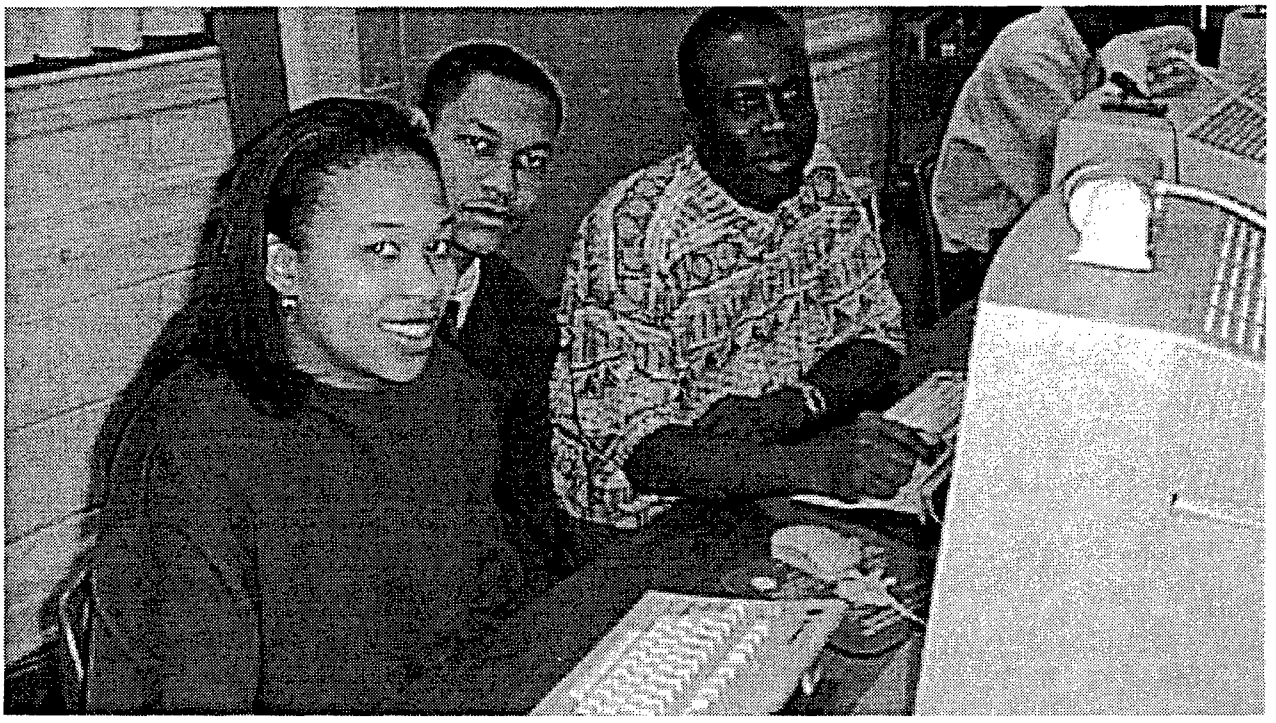
# *Visualization*



*Team Mentor: Dr. K. Edoh*

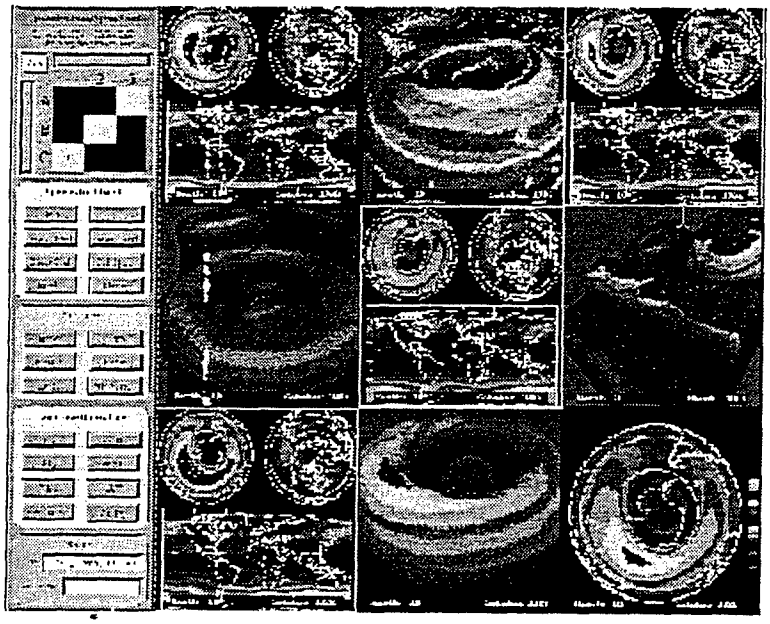
*Team Members: Kuchumbi Hayden*
*Alicia Jones*

# Earth Observing System (EOS) Distributed SpreadSheet NASA Sponsored

**Categories** Distributed Computing, Digital Libraries, Collaborative Computing

**Vision**

Provide users with tools to perform advanced visualizations of very large datasets by the use of Interactive Image Spreadsheets. The Distributed Image SpreadSheet will provide access to terabyte Mission To Planet Earth (MTPE) archives, remote Earth Observing System (EOS) scientists, distributed tools and specialized hardware, and metacomputing resources.



**Why NREN?**

The Distributed Image SpreadSheet (DISS) was developed by NASA Goddard Space Flight Center (GSFC) to provide users with tools to perform advanced visualizations of very large datasets. This type of tool is essential for scientists to allow them to analyze the large amount of data produced by next-generation satellite systems, such as EOS, that are expected to produce from 1 to 2 Terabytes of data per day.

**Description**

The Distributed Image SpreadSheet (DISS) was developed by Dr. K. Palaniappan, now at the Univ. of Missouri Columbia (UMC), and Dr. Fritz Hasler of NASA Goddard Space Flight Center (GSFC). The DISS is based on a

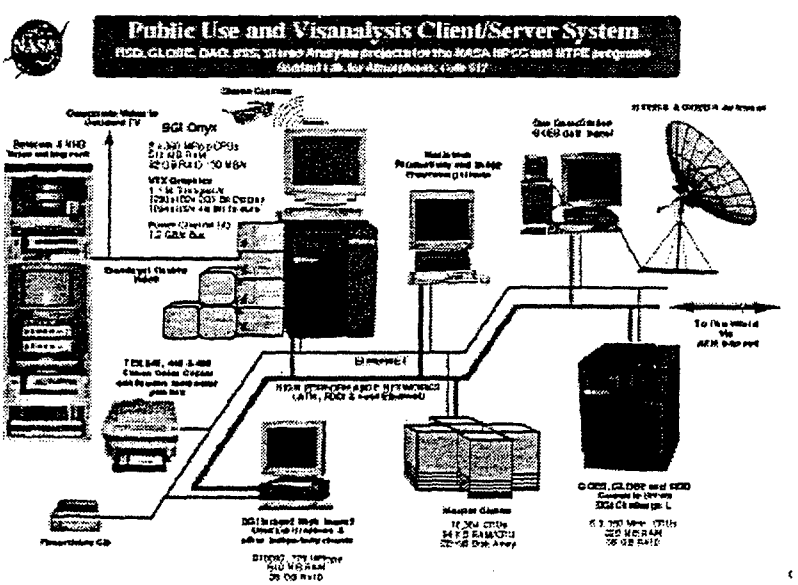
high performance compute engine and a user visualization terminal. The current version of the DISS is available to researchers for evaluation, and is under continuous development in the Laboratory for Atmospheres at NASA/GSFC and the Computer Engineering and Computer Science department at UMC. Network connectivity, testing, and performance evaluation was provided by the NASA Research and Education Network (NREN) and the Earth Science Data Information System (ESDIS) networking group at GSFC.

DISS is a highly interactive visualization and analysis (visanalysis) tool which combines a traditional spreadsheet paradigm with image processing, scientific visualization, and data archiving functionality. The DISS is a type of scalable visanalysis tool that is essential for scientists, enabling the analysis of the large amounts of hyper-image data produced by next generation satellite systems. NASA's contribution to Global Change Research is EOS, which is expected to have a total data production of 1 to 2 TB/day.

DISS provides users with tools to perform advanced visualizations of very large datasets such as the organization and comparison of almost 12 years of Total Ozone Mapping Spectrometer (TOMS) data. Other sample data sets used to show the development and evaluation of the functionality of the DISS include NOAA Advanced Very High Resolution Radiometer, NOAA Geostationary Operational Environmental Satellite, Landsat Thematic Mapper, Special Sensor Microwave/Imager, Airborne Visible and Infrared Imaging Spectrometer, NEXRAD, P3 aircraft radar, and EOS assimilated numerical model data produced by Goddard's Data Assimilation Office.

*Technical Summary:*

Configuration of the Image Spreadsheet System (non-distributed)



*Demonstration:*

In June 1997 at the National Center for Atmospheric Research (NCAR) in Boulder, Colorado, DISS was demonstrated for the first time at the Global Observation Information Network (GOIN) workshop, a US-Japan bilateral demonstration of information networks. For this demonstration, the user client workstation (a remote visualization terminal operated at NCAR) accessed data remotely at GSFC (about 1500 miles away) from a high performance storage system via a high performance WAN. The WAN connectivity included a NASA NREN connection at OC-3 rates to NCAR via a vBNS connection at San Diego Supercomputing Center at OC-12 rates, and Fiber Distributed Data Interface (FDDI) network interfaces for the server and client.

In September 1997 at NASA Ames Research Center in Moffett Field, California, DISS was demonstrated using Asynchronous Transfer Mode (ATM) end-to-end for the first time. An OC-3 connection using NREN's network via the Sprint ATM Cloud was established between GSFC and Ames for the NREN Workshop. Application performance of the DISS dramatically improved by a factor of ten using ATM end-to-end.

*Schedule:*

The initial demonstration occurred June 23, 1997, at the NCAR in Boulder, Colorado, as part of the GOIN US-Japan initiative. A second demonstration at the NREN Workshop 2 (September 1997) successfully used ATM end-to-end between GSFC and ARC.

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**Benefit**

Distributed visanalysis and high-speed remote access to geophysical data archives via high performance networks is critical to the success of NASA's Mission to Planet Earth program. The Goddard ESDIS project collaborates with the Ames NREN project for the purpose of prototyping EOS Data Information System (EOSDIS) applications. The DISS is an EOS application that is expected to be widely used by the EOS community. The DISS tool is important to other agencies involved in data analysis and modeling for aeronautics, astrophysics, geophysical studies, environmental monitoring, and mapping. The DISS tool with NREN connectivity facilitates public and commercial use of meteorological datasets; for example, broadcast weather services such as NBC WRC-TV already use NOAA's satellite imagery processed by NASA using this system on a daily basis.

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**Requirements**

DISS has several modes of distributed operations. In one scenario, the user visualization terminal is remote from the compute engine, and connected via a high performance WAN (e.g., NREN) which is used for communicating graphics rendering information. In another configuration, the compute engine accesses remote data over a high performance network using distributed file systems or direct client-server protocols. These distributed modes of operation may also be combined and used with Web technologies (e.g., Java). Initial testing and operation of the DISS will need effective network performance of at least 100 Mbps. Eventually, the server will have the potential to operate at near gigabit and higher speeds when pulling in data from multiple remote sources or serving multiple collaborating distributed users.

Networked visual analysis (visanalysis) requirements include:

- Bandwidth: 50 MB/s access to 100 GB "Redundant Array of Independent Discs"
- Latency: Low latency (< 0.5/second for interactive visualization and responsiveness)
- Data: Distributed MTPE datasets and archives
- Collaboration: Distributed Image SpreadSheet visualization with client and server sharing workload
- Video: Novel virtual environments and distribution of multimedia results

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**Partners and Potential Partners**

Partners will include other government agencies involved in atmospheric analysis, including NOAA and NCAR.

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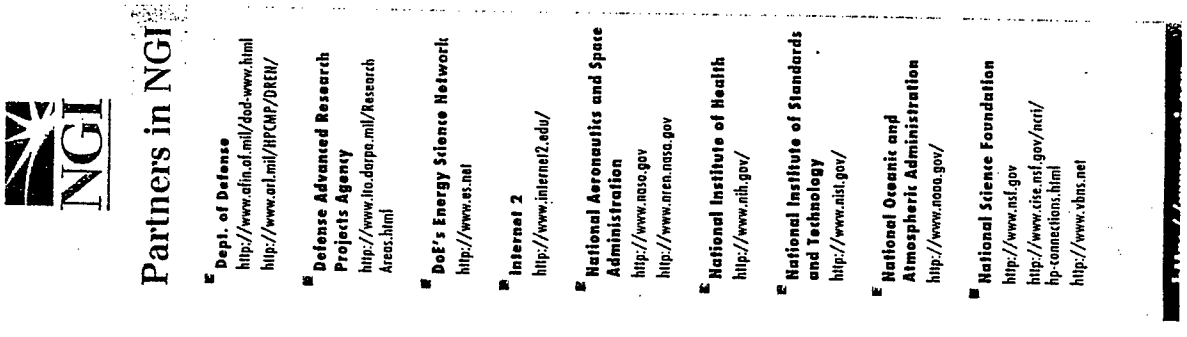
**URLs**

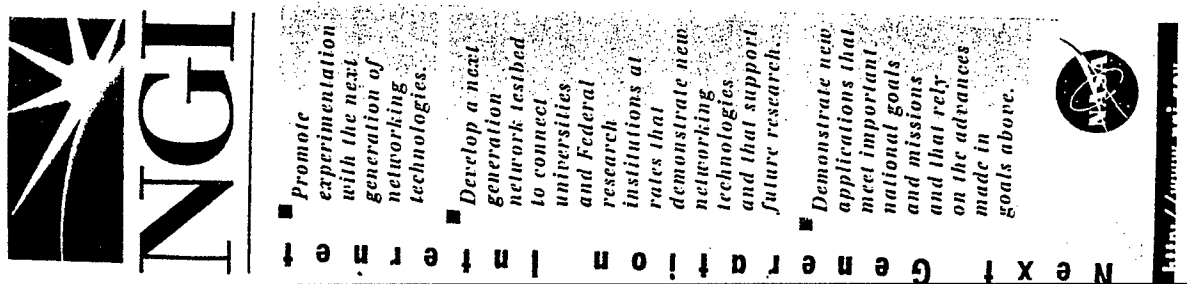
- http://rsd.gsfc.nasa.gov/rsd/
- http://rsd.gsfc.nasa.gov/rsd/IISS.html
- http://globe.gsfc.nasa.gov/globe
- http://rsd.gsfc.nasa.gov/users/palani/

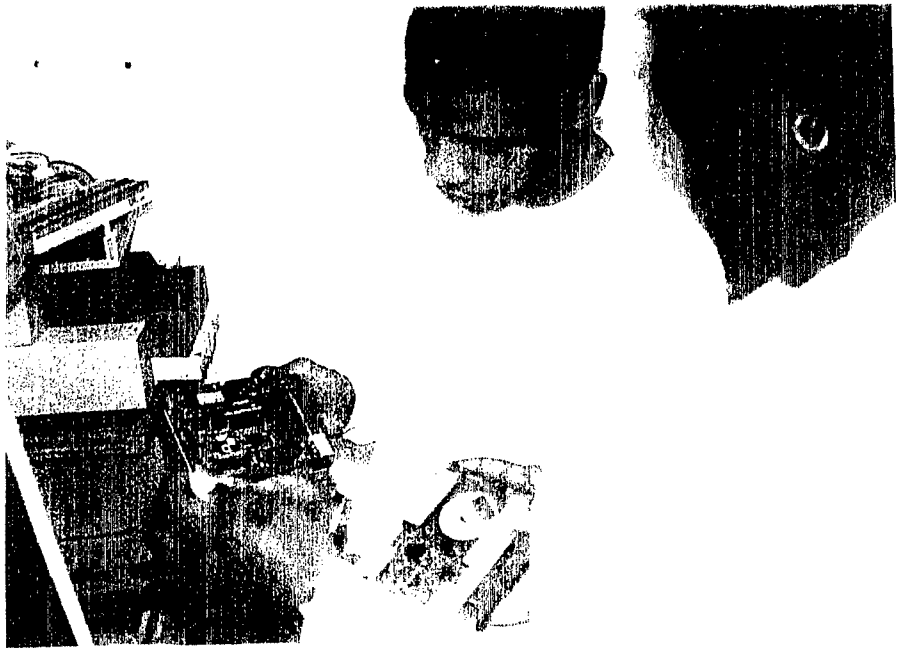
To download DISS for SGI:
ftp://agnes.gsfc.nasa.gov/pub/iiss

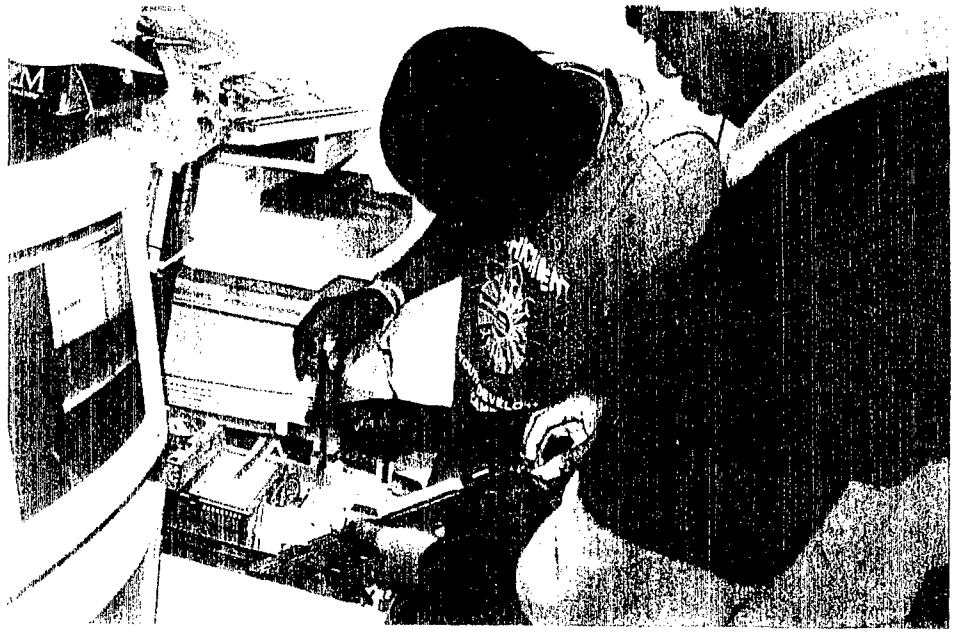
To contact Dr. Palaniappan:
http://rsd.gsfc.nasa.gov/users/palani

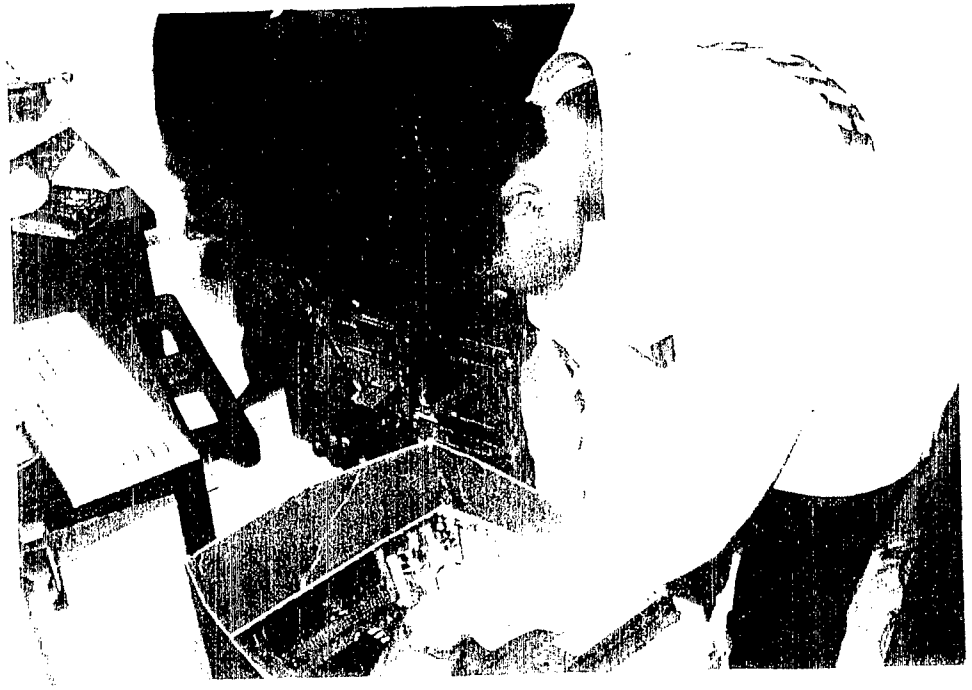
To locate more information on NREN and its applications:
http://www.nren.nasa.gov



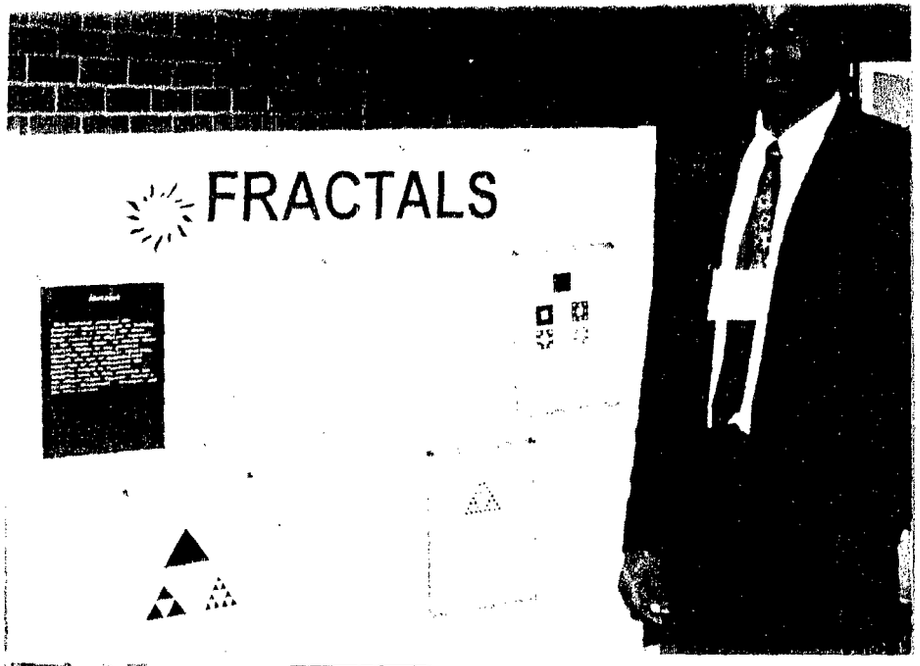





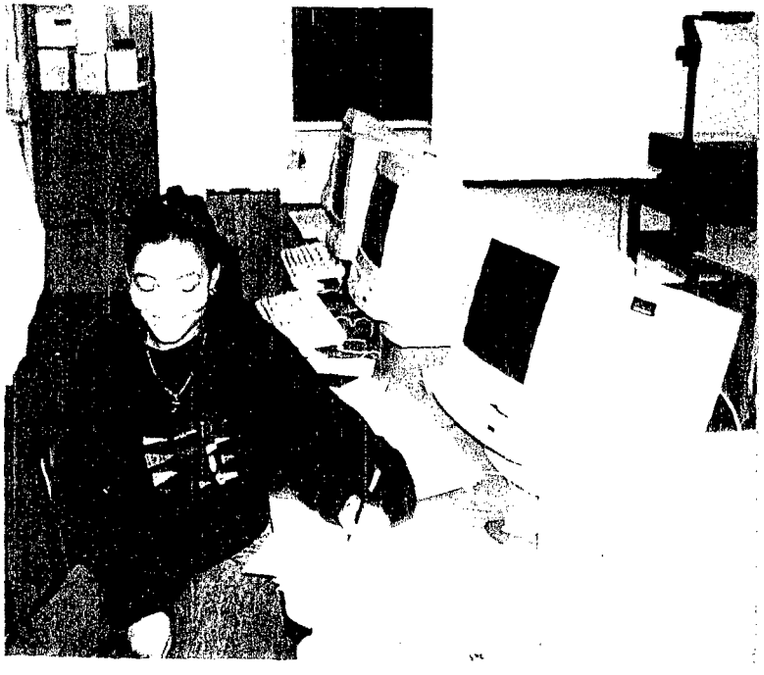




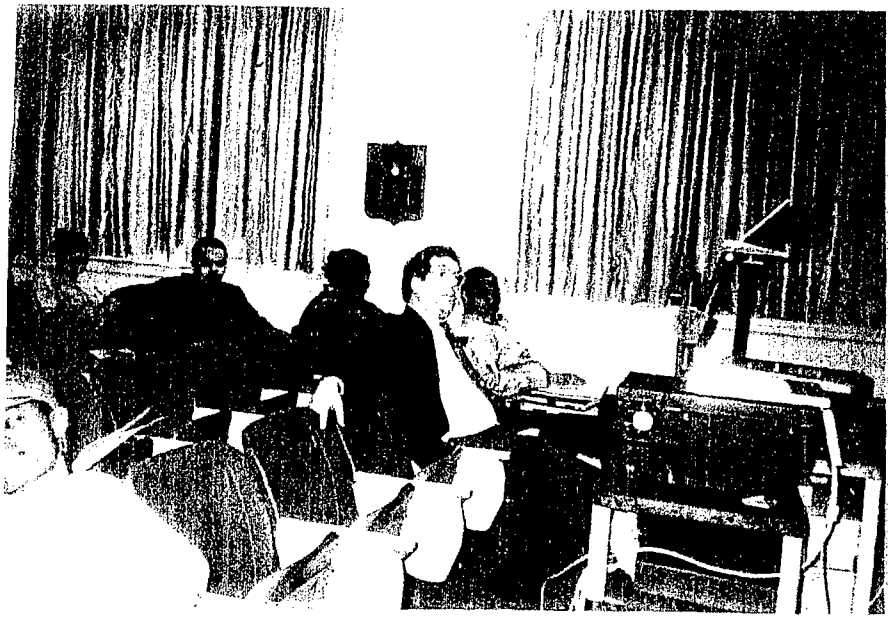
# 1997-98 Highlights

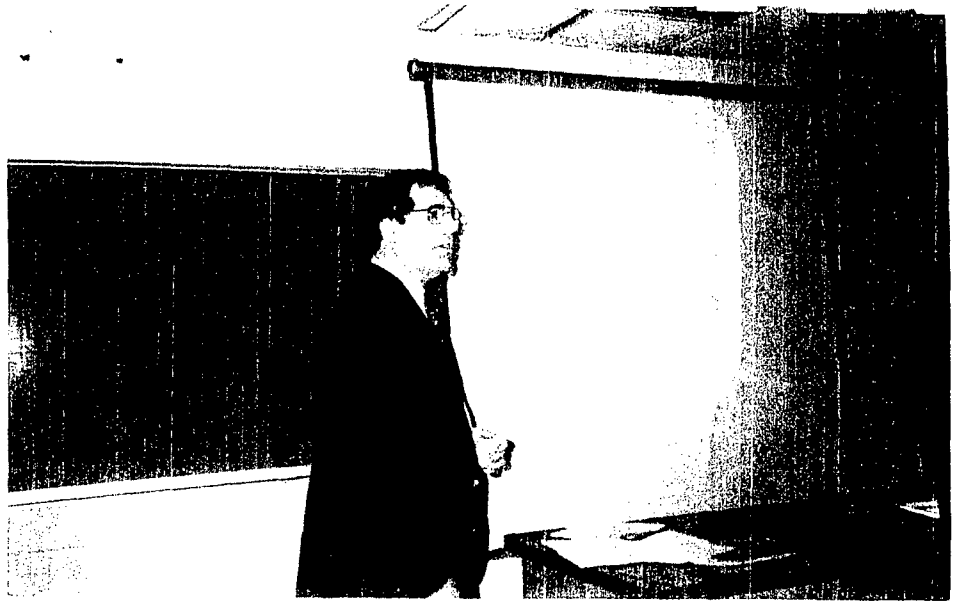






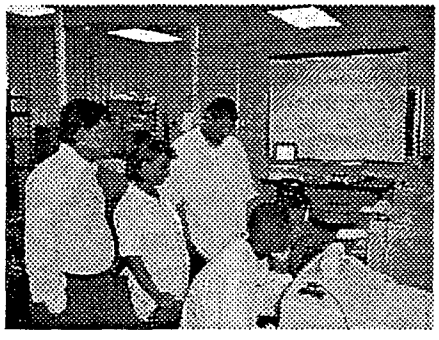
# 1997-98 Highlights

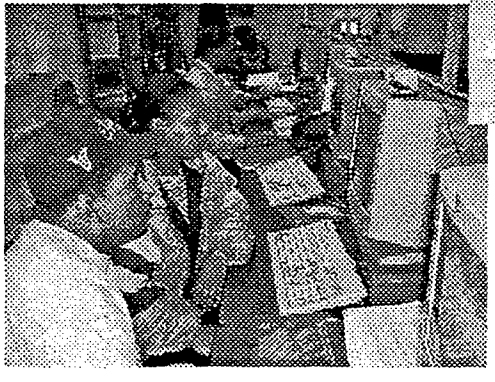


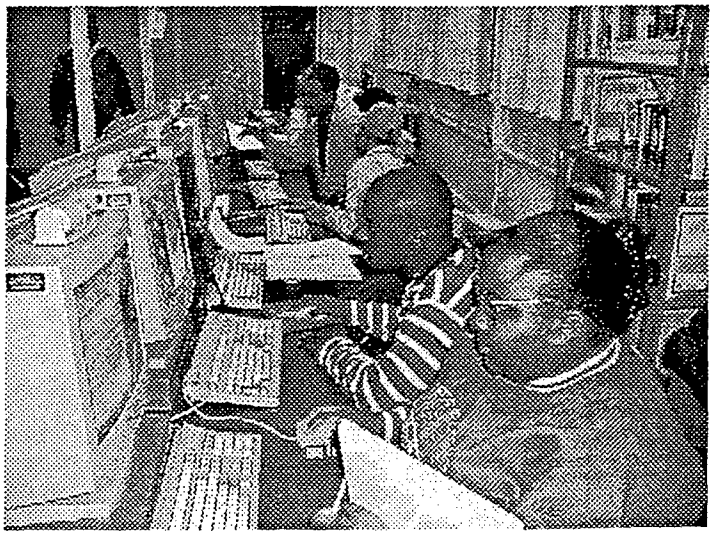


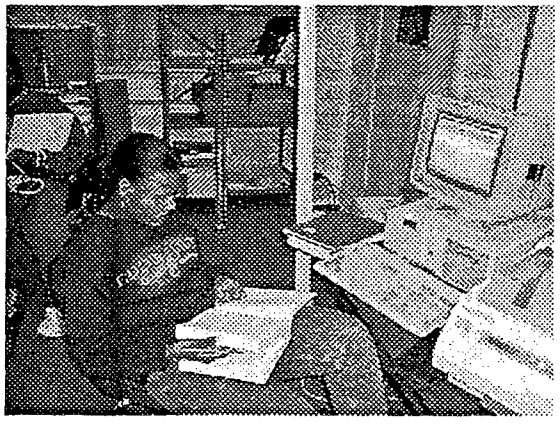
Visiting Lecture - Next Generation Internet (NGI)
Andy Germaine, Engineer, Swales Aerospace Inc.

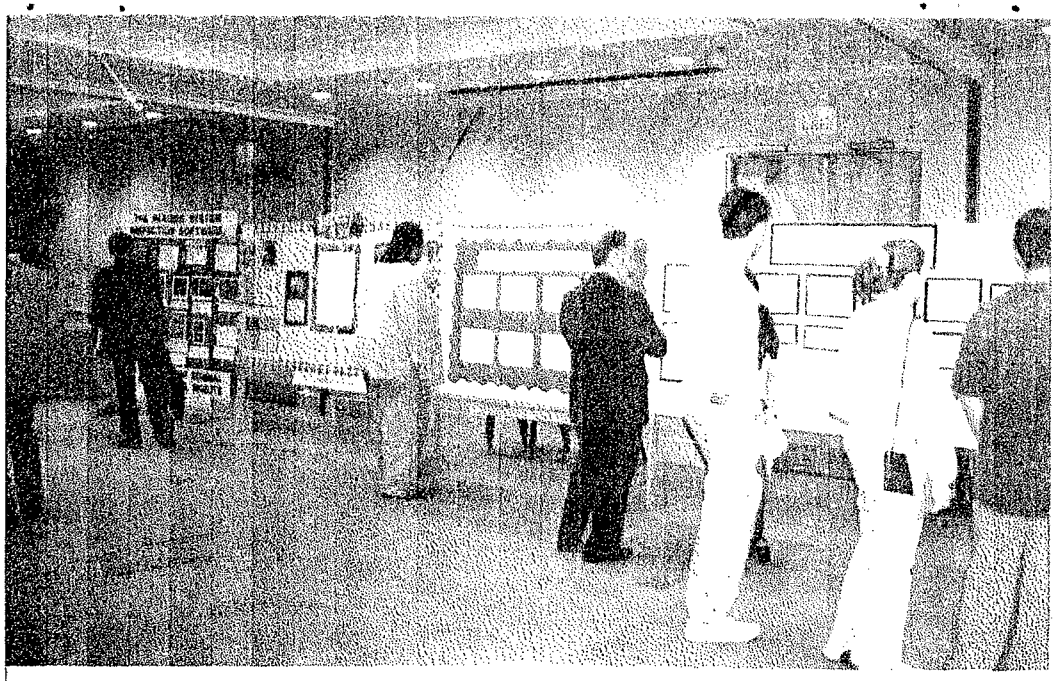
# 1997-98 Research Training Highlights

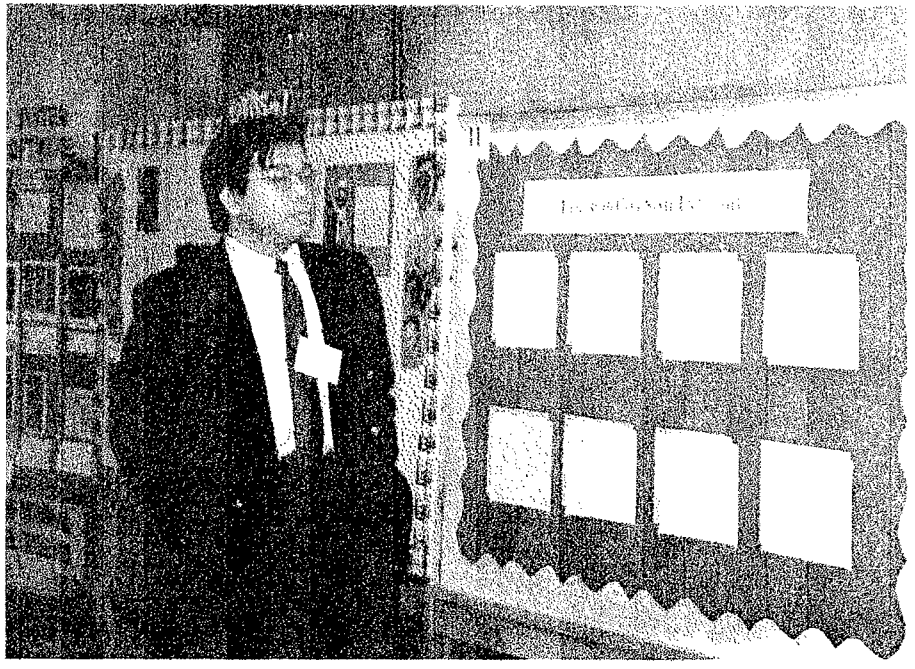






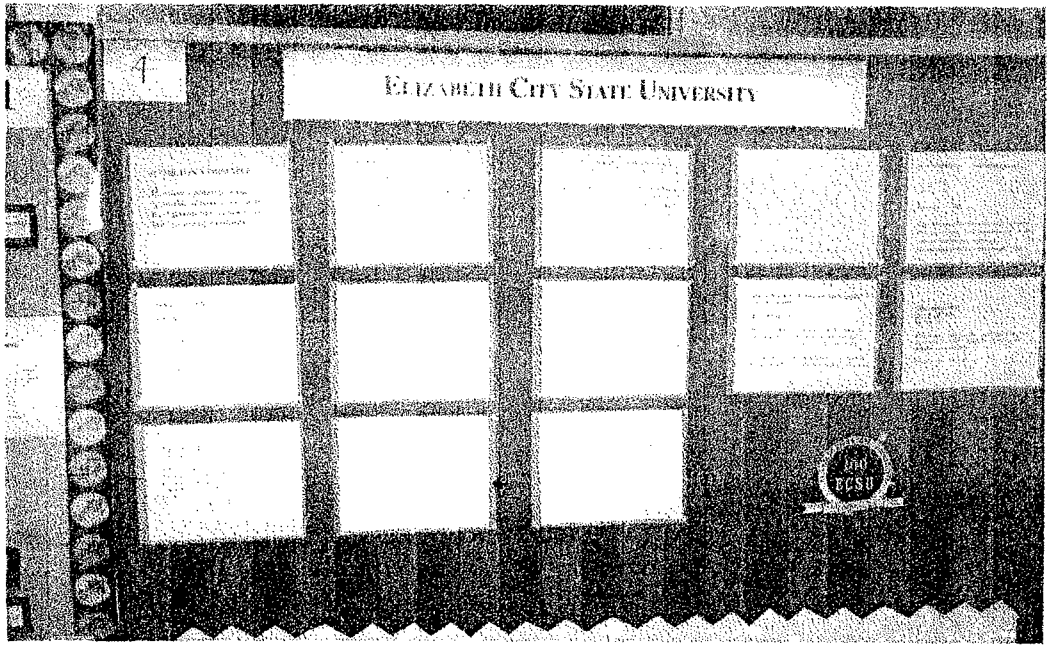


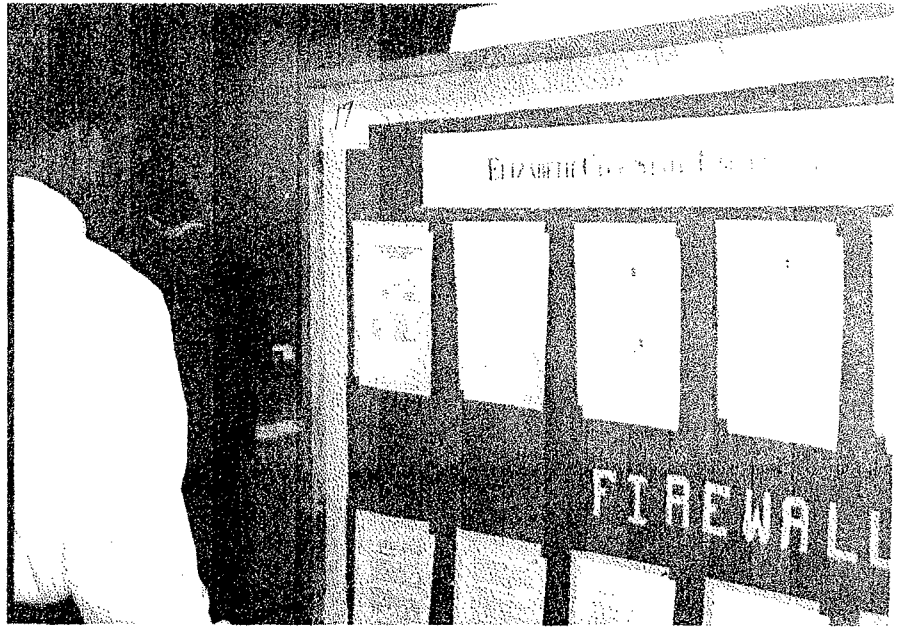




# Highlights

1998 Department of Energy HBCU Research Symposium
Ocean City, Maryland April 26-29, 1998

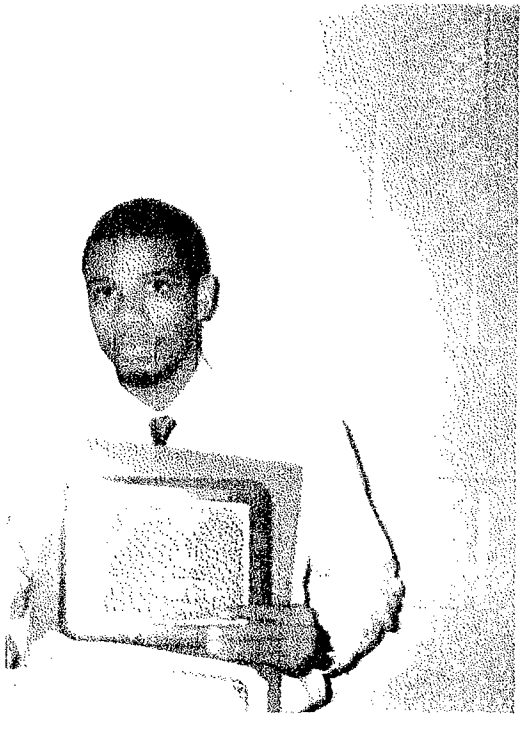


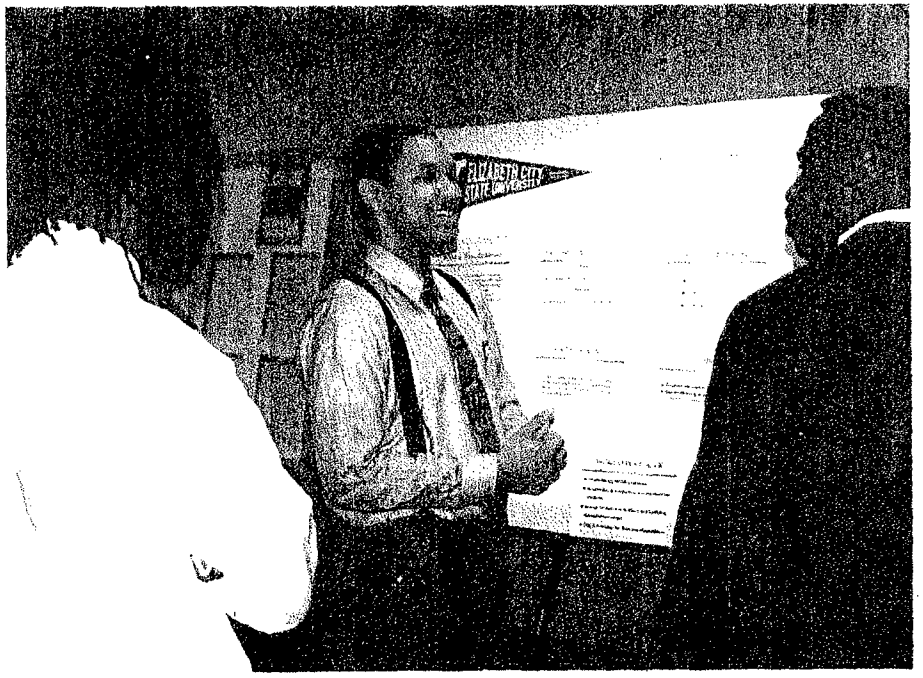



# Highlights

## 1998 Honors and Awards Day

Elizabeth City, NC April 16, 1998

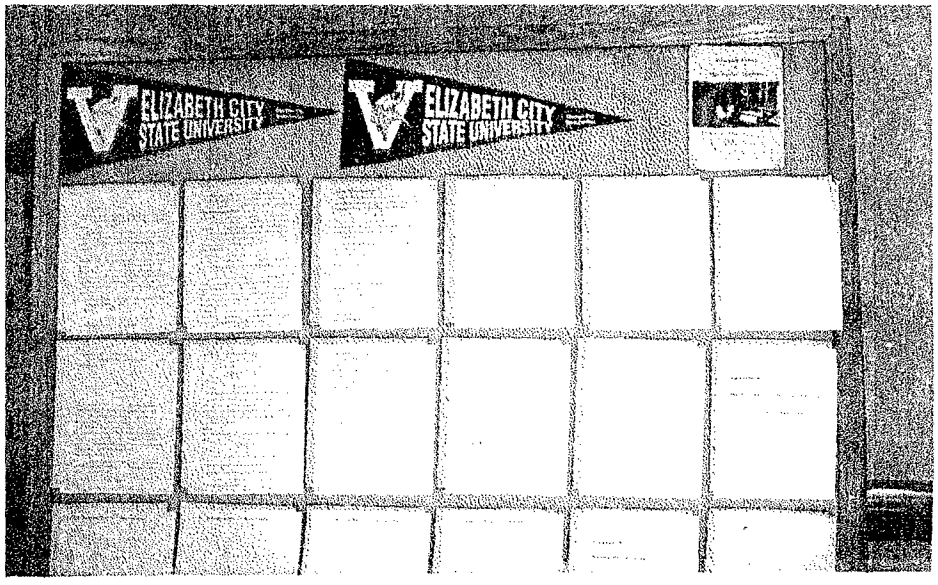





# Highlights

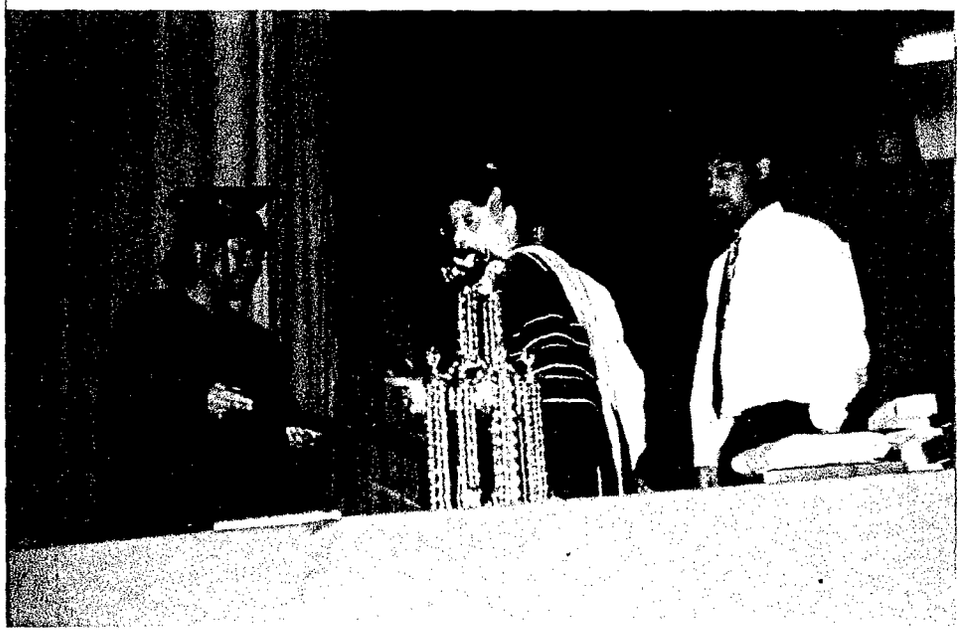
## 1998 NAFEO High Tech Undergraduate Student Expo

Washington, DC April 17, 199?



Above: Dr. Hayden is shown during the Press Conference to announce ECSU as the first HBCU to commercialize a NASA technology. Also shown below is Brian Jordan (Math Graduate Student-HU) as he discusses graduate school experience with Laverne Williams (Senior CS Major - 1998 GEM Fellow)

Below: During Honors and Awards Day, Corey Ellis (right) and Charles Gatling accept awards.



# 1997-98 Research Training Highlights